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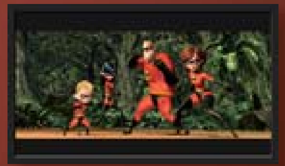

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September/October 2006

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MISSION STATEMENT

The mission of *Ultimate Home Design* is to serve as a catalyst for homeowners to create demand for architects, designers, and builders to adopt the concepts and building practices that define human-centered, optimum-performance home design. *Ultimate Home Design* is aimed at broadening the segment of the American population that is paying closer attention to the products they buy, looking beyond price and branding to focus on other elements of the production and value chain. Increasingly homeowners want to support sustainable building practices that result in a higher living standard. *Ultimate Home Design* is for those homeowners who want to promote a broader shift in patterns of production and consumption by encouraging practices that better reflect their personal values. We are advocates for using products that reduce energy and use renewable, recycled content or otherwise environmentally preferable materials. An important part of our mission is to promote building practices that result in a substantial reduction in energy use for space conditioning, water heating, lighting, and appliance operation. Another important aspect of our mission is to promote construction practices that improve the indoor environment and reduce the risk of building-related illness. This translates to improved occupant health and comfort by improving thermal comfort; natural lighting and electric illumination; and controlling humidity, odor, noise, and vibration.

Ultimate Home Design is for the thinking homeowner, who wants to be educated and learn about intelligent options for home design, whole-house system design, and comprehensive electronic lifestyle features that can enrich the quality of day-to-day life while reducing the cost of operating a home. With the knowledge gained reading *Ultimate Home Design*, you will be empowered to make intelligent choices about the design and make-up of your home, whether considering remodels or additions, planning a new home, or evaluating an already-built home. *Ultimate Home Design* will explore the wide range of possibilities within the context of designing Optimum Performance Homes™ that integrate universal design architecture; sustainable green building materials and techniques; energy-efficient power systems for electricity, lighting, heating, and air conditioning; water conservation techniques; and comprehensive electronic lifestyle features.

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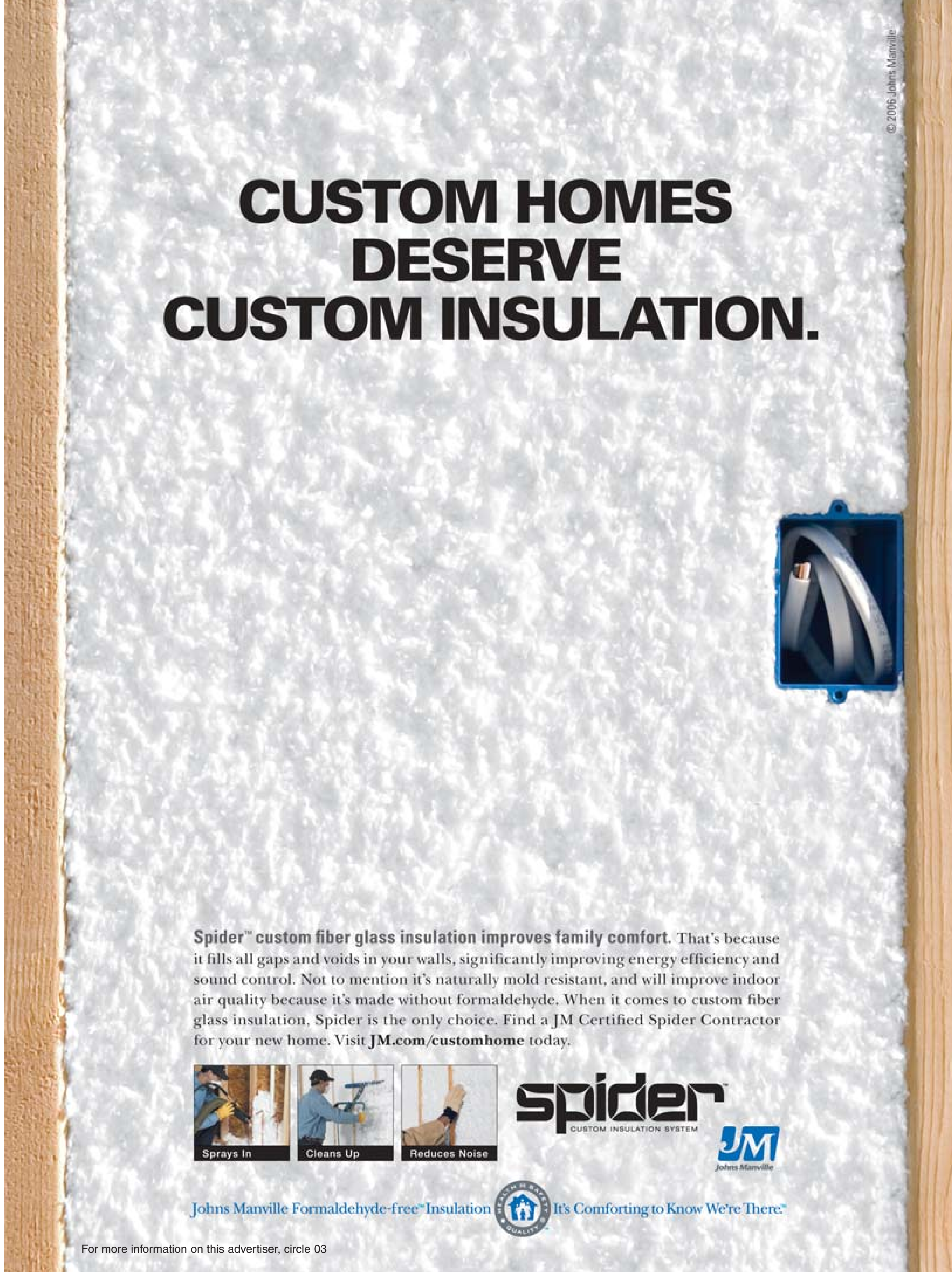

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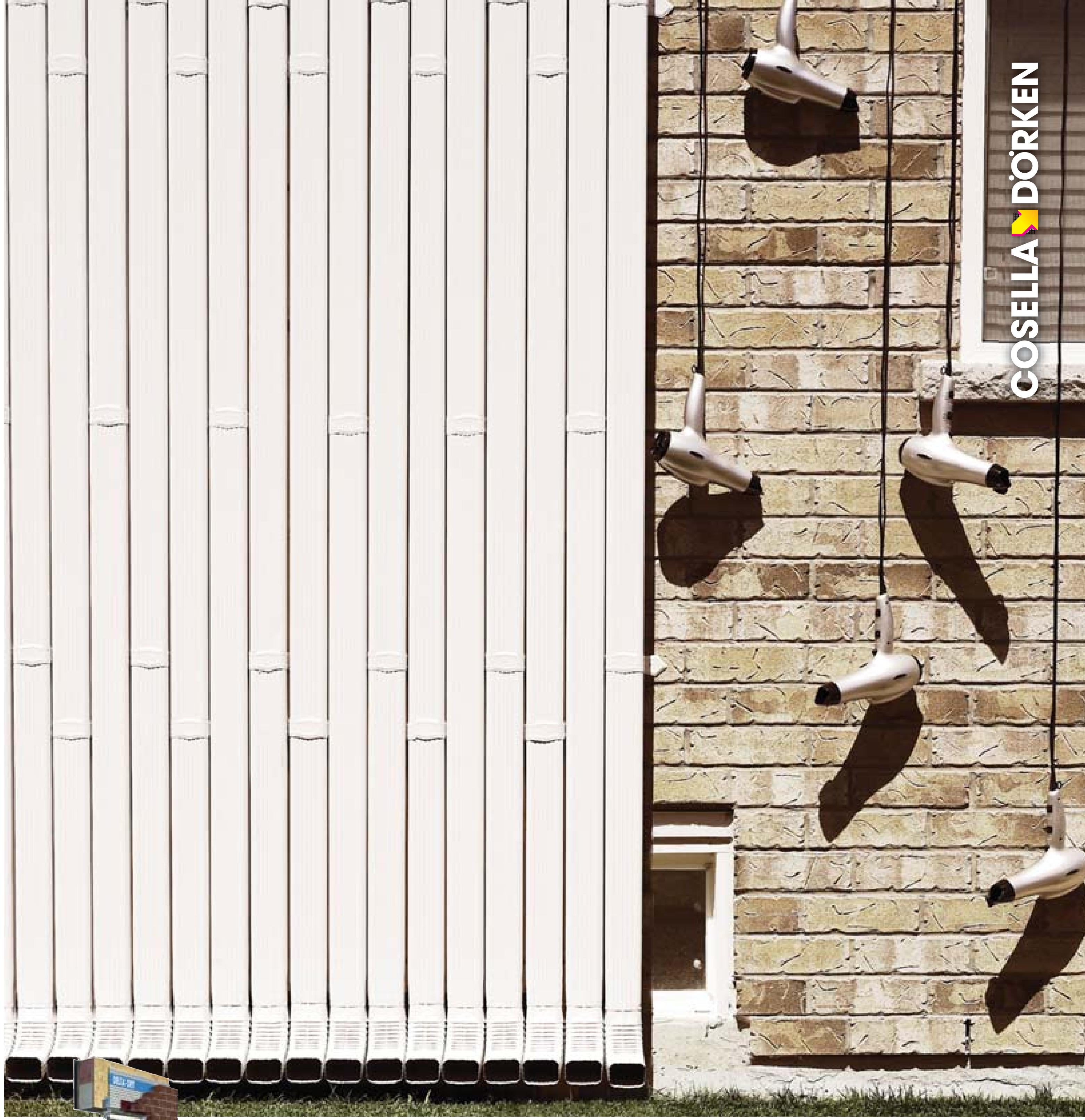

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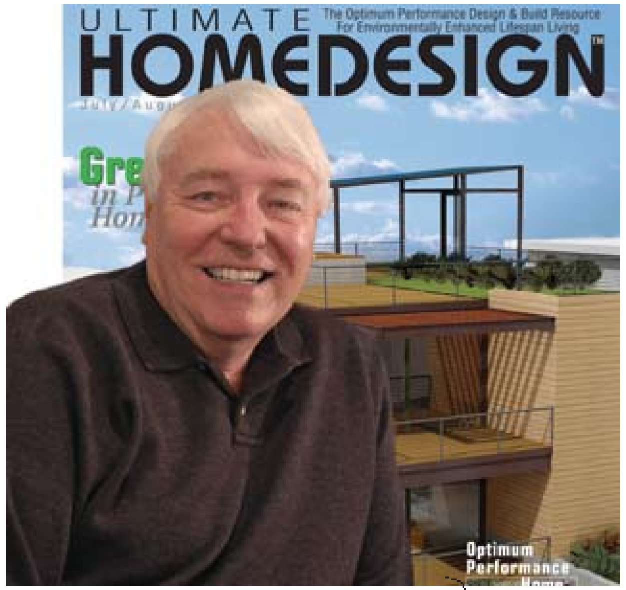

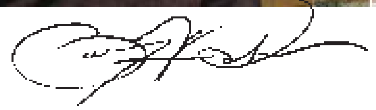

Vision And Pertinacity

In past issues, guest writers and I have presented viewpoints on how to successfully engage in the process of home design conception, design team management, and construction. This is a challenging task that requires knowledge and skill to bring a unique project together and achieve the specific project goals you have established in the visionary stage. As the leader of your design team, you should delight in the act of creation and enjoy the actual day-to-day process of design, re-design and further re-design, team coordination and communication, agency approval and permitting, product and material selection, project scheduling, construction site supervision, construction quality oversight, and fit-and-finish detailing at completion.

There will be numerous challenges along the way to completion. Engaging in such a process is not for everyone, and one must be prepared for a long journey that can usually take two or more years to completion. The "or more" depends on numerous factors and as documented in our running case study article series on the design and building of the first Optimum Performance Home™, that project timeline will extend to a full five years until completion. Unlike other custom home projects, this project was/is subjected to a community oversight design review process that unnecessarily deterred design certification and final approval. Thus, one should be prepared for a long journey dictated by a time-consuming and often frustrating process that is expensive as well. But the reward will be a superior home that will reflect your values and lifestyle, and that will sustain you and your family for a lifetime.

In this process, the time spent to define your specific project goals and identify practical, artful solutions is time well spent. The result will be the foundation for your design approach. Preparation is a critical element before engaging a design team to complete the detailed designs that will realize your vision. This will require extensive and time-consuming research. The more research you do and the better you are educated about the various options you'll have to select from will prove, over time, to be well worth the effort. You'll want to ensure that you set the stage for your design team to develop your project goals and the specific design strategies you have researched. With clear goals your team members will be able to make substantive contributions. The resulting design plan needs to be your compass to your destination—a superior home.

You'll need to assemble your design team and the builder, construction contractor or superintendent, key consultants, and all of the trade supervisors just prior to actual commencement of construction to ensure that the group clearly understands the project goals and their individual roles in contributing to the successful achievement of those goals. Respectively, each should be given a detailed scope of work, which, other than specifying the obvious specific work tasks expected to be completed, should identify the required coordination between trades. At the conclusion of this confab, preferably on site, the specifics noted on the construction drawings and in the specifications should be incorporated into the final detailed scope of work, which will become the blueprint that clearly defines the tasks that each trade is responsible for completing.

Other than your responsibility to verify at each stage of construction that the home is built according to the stated project goals and specific scopes of work, the last stage is a final walk-through with each trade supervisor to verify that his or her work has been completed to satisfaction, and to review the written operation and maintenance requirements related to his or her scope of work.

These final project stages are well documented in Part III in the series, "So You Want a LEED® Home...what's it going to take to get one built?" authored by Jay Hall, Ph.D. and Ann V. Edminster, M. Arch. As with the previous articles in this series, I recommend you read this article focused on the construction phase of a project. They provide a specific agenda for the successful completion of a home building project, whether LEED (Leadership In Energy & Environmental Design) qualified or not.

In the end, if you have fully engaged in the necessary workings of the process, the result will be a home that performs according to your specific project goals—a home that proudly reflects your vision and pertinacity.

EDITOR'S space

Inside This Issue

Part V continues as a case study of the design and building of the first Optimum Performance Home™, a Platinum-level LEED® for Homes project. LEED is a certification program of the U.S. Green Building Council. Complementing the case study are two articles pertaining to the mechanical infrastructure design for the Optimum Performance Home authored by Lisa Meline, P.E. and Norm Ehrlich. They provide informative introductions to geothermal and solar thermal technologies and their application in home design to significantly reduce energy costs. This article discusses the scope of the technologies and methodology used in the design of the home's elaborate mechanical infrastructure. In the next installment in this series, the structural infrastructure will be presented, which will address site preparation, foundation construction, and water proofing. The various building forms to be employed will be covered, including insulated concrete forms (ICF), structural insulated panels (SIP), and steel interior framing.

Our cover story features the electronic lifestyle of home theatre luminary Sam Runco, founder and CEO of Runco International, a premiere high-end video projector manufacturer. Sam and Lori Runco show how to remodel with flair, emphasizing an ultimate home theatre experience integrated with an enthusiast's kitchen and informal quarters.

A showcase for the U.S. Department of Energy's Building America program is the Borrego Springs, California project home, which demonstrates green building methods. The article's focus is on new ways to build highly energy-efficient, sustainable production housing for the entry-level buyer or move-up market.

Featured is an article on one of the first ultra-efficient demonstration homes to be built in the Maryland/Washington DC/Virginia market. The energy-saving PowerHouse is designed to ease the impact of rising energy costs.

Senior Touch principal Ayala Rahav makes the case for new designs for age-friendly home electronics and home-use medical equipment.

The new standard for wireless home controls, Z-Wave, is described by Yan Rodriguez as reliable, affordable, and product diversified. UHD

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Home System Allows Home Users To Monitor Energy Use

While American households are the most resource consuming in the world, they are unlikely to become more efficient users of public utilities because of: 1) large time delays between utility use and the receipt of utility bills; 2) the inconvenience of personally checking and recording gas, water, and electricity meters already existing in their homes; and 3) a generally poor understanding regarding the relationship between individual actions taken at home (e.g., adjusting the thermostat, water heater control, etc.), and the potential for personal cost savings in the long term.

But this is about to change...

A team of students at the University of Michigan in Ann Arbor—which was one of seven to win a top honor out of 64 student teams invited to participate in a recent finalist competition at the National Mall in Washington DC—has developed an award-winning monitoring system that alerts homeowners when they exceed their pre-set monthly limits for utility costs, enabling them to conserve energy in time to lower their bills.

A computer-based AWARE@home tool lets homeowners monitor their total consumption of electricity, gas, and water in real time, and a wireless wall plug allows the electricity consumption of individual appliances to be monitored on the same system.

Energy consumption is indicated on the system in dollars or environmental emissions and delivered to the homeowner automatically in real time and on-demand through a wireless network, according to Steven Skerlos, Assistant Professor of Mechanical Engineering and advisor to the student project.

To get the energy-consumption monitoring system up and running, the utility provider first swaps out the analog meter for a digital one. Then the consumer gets a start-up kit that includes a CD and, if needed, a USB wireless antenna for the computer.

After loading software from the CD onto the computer, homeowners are asked basic questions about utility rates, billing cycles, and how much they want to spend on utilities each month. At any point in the month when it looks like the desired utilities expenditure will be exceeded, the AWARE@home will notify the homeowner by email and direct them to a site on the Web where they can find information on how to reduce consumption. For advanced users, interested in both cost and environmental impact reduction, the software interface will allow the homeowner to monitor his or her utility usage rates and determine the optimal ways in which a homeowner can adjust his or her usage to reduce cost (children could also be given such assignments in school, in effect allowing students to educate their parents). For such advanced users, simple "wireless plugs" will be designed that will allow wall outlets to communicate with the same system, so the impact of specific appliances on overall energy consumption can be monitored if desired.

Power companies, landlords, meter providers, and appliance manufacturers have already expressed interest in the system, said Skerlos. Eventually, the design team hopes to see their invention reduce residential utility consumption in the U.S. by ten percent.

This invention won one of the Environmental Protection Agency's first P3—People, Prosperity, and Planet—Awards in a design competition seeking profitable sustainable development technologies from universities.

A Little About P3

P3 is a partnership between the public and private sectors to achieve economic prosperity while protecting the natural systems of the planet and providing a higher quality of life. The P3 competition and awards provide grants to teams of college students to research, develop, and design sustainable solutions to environmental challenges. P3 highlights people, prosperity, and the planet—the three pillars of sustainability—as the next step beyond P2 or pollution prevention.

The P3 Competition consists of two phases. In Phase I, student teams compete for P3 grants, and the winning recipients are awarded $10,000 to research and develop their projects during the academic year. Phase II happens in the following spring when all P3 grantees are invited to Washington DC to compete for the P3 Awards. The awards provide an opportunity for additional funding to further develop and implement the technology designs.

The EPA will be accepting new applications for the Phase I 2007-2008 P3 competition. To view the Request for Applications, see: http://es.epa.gov/ncer/rfa/2006/2006_p3.html. UHD

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New
to the neighborhood

Sarah Scaglione

Uponor, Inc. Everyone enjoys a jump-start in the morning, but most would prefer it didn't come from stepping out of the warm shower and onto the freezing bathroom tile. Uponor redefines comfort with their hydronic radiant heating system, where warm water circulates through tubing that is installed directly under the floor. Heat radiates upward from the floor without having to adjust and re-adjust the thermostat. Homeowners experience 20 to 40 percent in energy savings over forced-air systems, making radiant heating incredibly energy efficient. Not solely for tile, radiant floor heating keeps all kinds of floors warm: wood, slate, linoleum, carpet, and even concrete. It can be installed during new construction and also works well in remodeling or retrofit projects. For lower utility bills and increased comfort, phone or visit Uponor today.
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Arxx™ Building Products is the leading manufacturer of ICFs (Insulating Concrete Forms) in North America. Arxx walls and foundations are in place across the U.S. and Canada, from simple crawl spaces, to custom three-story homes, to churches, schools, storage centers, office buildings, hotels, motels, restaurants, and the list goes on. Arxx walls are stronger, safer, and more energy efficient than traditionally built walls with a construction method that is fast and easy, requiring minimal training and reduced labor rates. Arxx is a "stay-in-place" concrete forming system—the forms are pre-assembled and light weight. Each form consists of two panels of expanded polystyrene held together with a polypropylene web. Once the forms are in place and rebar is installed, the concrete is poured, creating a monolithic insulated concrete wall. The result is a wall system that is highly energy efficient and strong. Unlike wood construction, there are no cavities or gaps where drafts can enter and molds can proliferate, enhancing the indoor air quality and temperature control, and also reducing sound penetration from the outside. 800 293 3210 visit www.arxxwalls.com

Rainbow Attic Stair® From their start in November 2002, they were told it couldn't be done—selling a radically re-designed attic stair that would retail for around $600 in a market dominated by $90 wood folding ladders. Four years, six new models, and nearly 600 dealers later, they continue to re-define the market with the introduction of GALAXY, the first remote-controlled attic stair in the U.S. Like their other stairs, GALAXY is constructed of heavy-duty powder-coated steel with a 350-pound capacity. The metal door not only gives it high insulation value but also a 30-minute fire rating. And, of course, the remote-control feature makes it effortless to operate. The Rainbow Attic Stair has been featured on *The Weekend Handyman Show*, HGTV, and in a number of trade publications. For complete information on their products and a list of dealers, visit www.Rainbowatticstair.com.

Johns Manville has announced the introduction of their Formaldehyde-free™ Spider™ Custom Insulation System—a spray-in fiberglass insulation that completely fills wall cavities, and eliminating all gaps and voids where energy can escape. In addition to providing complete cavity coverage, Spider reaches R-values of R-15 in a 2 x 4 wall cavity and R-23 in a 2 x 6 wall cavity, providing homeowners with the ultimate energy-efficient solution. Spider is made without formaldehyde and will contribute to improved overall indoor air quality in tighter built, energy-efficient homes. Spider contains 20 percent post-consumer and 5 percent post-industrial recycled glass, and what's not made from glass is made from sand—an abundant and rapidly renewable resource. Because Spider is made from inorganic fiberglass, it naturally does not support mold growth and is further protected with an EPA-registered preservative, the same product used in food to prevent mold growth. 800 654 3103
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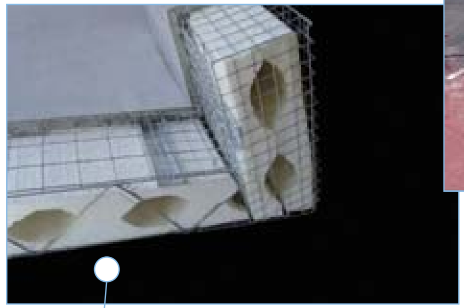

Green Sandwich® Technologies Defining energy efficiency with their structural concrete insulation panels (SCIPs), Green Sandwich Technologies' patented building system enables architects and developers to create beautiful, sustainable structures faster and more economically then ever before imagined. Engineered, not manufactured, this innovative product can be used for floors, roofs, walls, countertops, and pools. With a wind-load capacity of 200+ mph, these panels withstand hurricanes, F-3 tornadoes, and even 8.0+ earthquakes. Utilizing BASF's environmentally friendly Styropor EPS foam in its panels, Green Sandwich panels are made from 40 percent recycled material content by weight and 60 percent by volume. Boasting an R-40 insulation rating, these panels can save occupants 40 to 60 percent on energy costs. 818 771 5200
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Noveon, Inc. A FlowGuard Gold® CPVC plumbing system offers a cost-effective alternative to copper systems—especially with copper prices more than doubling since the end of 2004. CPVC, which has been successfully installed in residential and commercial projects for more than 45 years, provides superior energy efficiency due to its natural thermal properties and significantly less condensation, an issue for people concerned about mold. Additionally, FlowGuard Gold systems are easy to install with a one-step solvent cement joining system that requires no soldering to significantly decrease labor costs. And with FlowGuard Gold systems, there is no scaling—meaning its water-carrying capacity never diminishes. Homeowners prefer FlowGuard Gold systems because they maintain water quality due to their corrosion resistance, virtually eliminate water hammer, and provide a long-lasting plumbing system that is nearly maintenance free. To find out how you can benefit from a FlowGuard Gold CPVC plumbing system, phone 888 234-2436 or visit
www.flowguardgold.com

CorkDirect In the new construction of a large private home near Atlanta, Georgia, a CorkDirect floating floor provides the ideal surface for a definitive private exercise room. A cork floating floor has an integral underlayment of soft, flexible cork built into each interlocking plank. Unlike tile, wood parquet, or any other hard surface, cork has an intrinsic resilience and a capacity to compress and flex, which provides comfort and great safety. Widely used in vacation homes and ski resort areas, CorkDirect floors offer a firm, smooth surface for a wide range of safety applications, such as retirement homes and medical facilities. In situations requiring resilient support, such as kitchens, where cooks are almost always standing; and in exercise, dance, and karate studios, cork provides a supple hard surface unlike any other. Cork flooring, frequently specified for purely aesthetic reasons, is proving to be the choice of environmentally conscious users as well, because cork is made only from the bark of the cork oak, a tree that is never felled. 800 344 2675 www.corkdirect.com

Syndesis, Inc. invites you to get creative with concrete. Introducing Syndecrete™—an advanced, 100 percent cement-based composite that utilizes natural minerals and recycled materials as its primary ingredients. This incredible product, void of resins or polymers, is less than half the weight with twice the compressive strength of normal concrete. Handcrafted to meet your personal needs, Syndecrete is heat- and flame-retardant and is resistant to staining, corrosion, and impact damage. Just a few of the many uses of Syndecrete include bathtubs, sink basins, countertops, floor tiles, showers, wall and building panels, and landscape elements. Sealed with an F.D.A.-approved sealer, this product is resistant to water penetration and potential food stains. LEED® certification points are also available. Get colorful with concrete. 310 829 9932 www.syndesisinc.com

KitchenAid® Distinctive styling, superior craftsmanship, and attention to detail are just a few of the features of the KitchenAid® Architect® I and Architect II Series. Now you can enhance not only the kitchen but other areas of the home used for entertaining with KitchenAid Architect Series II Undercounter Beverage Centers. With three temperature zones, homeowners can store red wines on the bottom rack, white wines in the middle, and additional beverages on top—all at the appropriate temperatures. The LED screen displays the temperatures of each zone for convenience and reliability. Beverage centers are available in stainless steel, black-on-stainless, and factory-installed overlay-style trim. 800 422 1230 www.kitchenaid.com

Building Knowledge, Inc. was founded by building industry experts, building science trainers, and educational specialists who are dedicated to improving the durability, energy efficiency, and healthiness of homes, and transitioning the home building industry to a new level of economic health and distinction. They offer a wide range of services, such as education, training, consulting, and research. Building Better Homes™ is a first-of-its-kind interactive educational program based on the Whole-House Systems Approach to residential construction. This comprehensive three-CD program takes builders, architects, remodelers, and subcontractors through the process of building higher performing homes that are more durable, energy efficient, safer, healthier, and more affordable to own and maintain. Building Better Homes is the perfect education tool. 952 944 5605 www.buildingknowledge.net

PRODUCT showcase

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Quiet Solution, LLC America's most trusted manufacturer of soundproofing products has introduced QuietRock 525, the lowest-cost, high-performance soundproof drywall panel. As the intricacy of home theatres and high-quality audio systems advance, so does the need for an enhanced listening environment. QuietRock 525 is the optimum solution to superior sound isolation. Boasting an STC value of up to 72, QuietRock 525 can be used just like any other gypsum or drywall product and can be used in new wall construction as well as retrofits. One sheet of QuietRock 525 is acoustically equivalent to eight sheets of standard drywall. The patent-pending CPG-composite technology uses advanced viscoelastic polymers, ceramics, and gypsum in a constrained layer fabrication. For the ultimate in soundproofing, contact Quiet Solution today. 800 797 8159 www.QuietSolution.com

Wayne®-Dalton Thanks in part to Z-Wave Technology, home automation is no longer exclusive to the tech-savvy, but is now for the masses. Wayne-Dalton makes controlling your home from the push of a button easier than ever. As garage doors steadily become our main point of entrance into our home, it would make sense that a Z-Wave-enabled garage door opener would allow homeowners to control not only the garage door itself but also lighting, security systems, thermostats, and even entertainment systems. This year marks the launch of Wayne-Dalton's three-in-one Z-Wave kit to simplify the setup process. The kit includes Home Gateway module, Keychain Remote Control, and Garage Door Opener Conversion Module. 888 827 3667 www.wayne-dalton.com/access

Leviton Manufacturing Company The Vizia™ Collection is Leviton's most advanced statement in residential lighting and home control technology. Incorporated into a stylish new form factor compatible with Leviton's hallmark Decora® design, the devices in the collection operate either as standard dimmers and switches, or expand functionality with wireless two-way communication, scene and zone control, and remote-control operation. They add touches of elegance and precise control with features such as soft fade-on/fade-off, selectable fade rates, and settable minimum brightness levels. Vizia-RF™ features Z-Wave® wireless radio frequency technology, offering performance equaling that of high-end systems, but at a lower cost. Benefits include ease-of installation in both new and retrofit applications and compatibility with hundreds of Z-Wave-certified household devices. 800 323 8920 www.leviton.com

Ultimate Electronic Lifestyle

Home Theatre Luminary Sam Runco's Home Vision

Gary Reber

Sam and Lori Runco enjoying their new entertainment and cooking quarters

synopsis

- *The challenge in designing the remodel was to stealthily hide all of the technology so that it is not seen when not in use, preserving the décor of the family room.*
- *Sam and his engineers have perfected the art of presenting CinemaScope™ movies in their original widescreen aspect ratio of 2.35:1 via their patent-pending CineWide™ technology that digitally stretches the image vertically to remove the dreaded "black bars."*

Introduction

Move, build new, or remodel? It is a question that many of us will inevitably face when one day we look around our home and think out loud, "This house is outdated." And so it was on a warm day last spring when Sam Runco, founder of Runco International and an acclaimed international home theatre luminary, sat his family down and rhetorically asked them if they wanted to move, build new, or remodel. See, Sam already had it in his head that he wanted to build a new house; one where his passion for video and cooking could be better expressed by building the ideal environments from scratch. Needless to say, it came as quite a surprise to him when the rest of the family said they wanted to stay in their

Runco UltraOnyx CineWide 2.76:1 aspect ratio projection screen

One might think that the projector in the dedicated home theatre would be the video highlight of the home, but it's the hidden projector in the family room that garners the true "wow" factor.

2,900-square-foot, standard California two-story "Leave It To Beaver" stucco home and live through remodeling rather than move. When he asked them to consider changing homes, they reportedly looked at him like he had two heads.

The decision revealed that their family and kid-active neighborhood in a quaint bedroom community in Northern California was already what they ever wanted, or needed. "Lori and I both grew up in neighborhoods where 'toys' meant you just walked outside to see a dozen friends. Why would I ever think my kids would want anything else?" With the relatively easy decision to stay and remodel made, the tough decisions on how and what to remodel still needed to be decided. With architects and electronics systems designers consulted, remodeling of the Runco home began. "It was a great, if comedic, moment when our interior designer and close friend, Lezlie Trujillo said, 'So, we don't have that extra couple thousand feet you wanted, but we can still turn this into a JEWEL.'"

Given Sam Runco is the founder of the world's leading manufacturer of high-end video products for the home, one of the first questions during the remodel layout was "where do the projectors go?" One might think that the projector in the dedicated home theatre would be the video highlight of the home, but it's the hidden projector in the family room that garners the true "wow" factor. The bulk of the Runco's time as a family is spent in the family room, which is now open to their new kitchen, separated by an informal dining room table. Sam and Lori like to be able to watch "the big screen" while they are cooking, as well as interact with the rest of the family, so

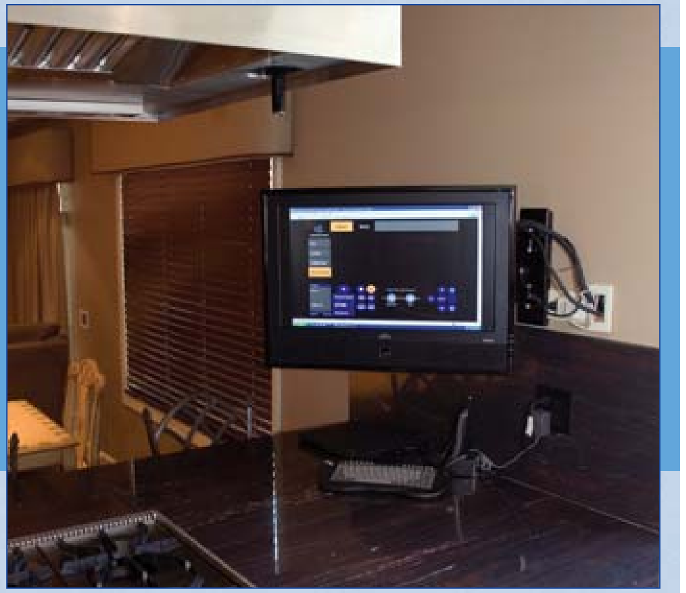
Runco 1080p Video Extreme™ VX-55d projector hidden in exhaust fan for the stove.

installing a projector and screen within view of the kitchen was a must. The challenge was to stealthily hide all of the technology so that it is not seen when not in use, preserving the décor of the family room. If the house would have been built from the ground up with this goal in mind, the challenge would have been much less daunting, as the projector could have been dropped out of the ceiling, but this was not an option afforded to them. The solution was to hide the projector in the same enclosure that houses the exhaust fan for the stove. First and foremost, a projector that would actually fit in the tight space had to be chosen. Sam had his engineers custom modify one of the company's not-yet-released 1080p Video Xtreme™ projectors, a $150,000 VX-55d (it's good to be Sam Runco) to fit in the enclosure, and other than the retractable hole cut out for the lens, it is completely hidden. Given the VX-55d is housed in a metal enclosure located above a stove top, proper ventilation was carefully planned. The projector enclosure gets its own air supply via a dedicated intake that draws fresh air from another room, so it doesn't collect grease from the kitchen, and exhausts hot air directly outside. "This is the secret of any good projector installation; it is imperative, even on many open installations, to properly ventilate the projector. You just have to get rid of that heat. Reliability and longevity is ensured when you do this according to strict Runco training guidelines."

Hiding the screen was the next challenge because not just any old 16:9 (1.78:1 aspect ratio) screen will do for Sam Runco. He and his engineers have perfected the art of presenting CinemaScope™ movies in their original widescreen aspect ratio of 2.35:1 via their patent-pending CineWide™ technology that digitally stretches the image vertically to remove the dreaded "black bars," and then through the use of an anamorphic lens, stretches the image horizontally correcting the image's geometry and filling the entire 2.35:1 screen. Of course, Sam had to go the extra mile of having a 2.76:1 screen custom made by the Runco engineering team so that he can watch an aspect ratio that only a handful of movies were made in. The format was called Ultra Panavision 70® and was created by MGM Studios. This format only lasted from 1956 to 1964, but the handful of movies made are considered among the most popular in movie history—*Mutiny On The Bounty*, *It's A Mad Mad Mad Mad World*, *The Greatest Story Ever Told*, and the one movie Sam built the screen for, the incredible *Ben-Hur*. "Getting that screen was some project. I wanted a screen that would always look like it was the size of the aspect ratio that it was in. In other words, I didn't want 1.78:1 to look like it was cropped from a larger screen. It had to look like a 1.78:1 to the trained eye so that when it opened to 2.35:1, the effect would be breathtaking. It also had to have a cutting edge on the masking no farther than 1/8-inch from the screen surface. This required a solid substrate

View Into Kitchen From Family Room

View Of Sam's Brunswick® 1946 Anniversary Pool Table



A Runco 26-inch widescreen LCD display turned into a full-blown touch screen tied into Sam's computer

on the screen. Finally, it had to show bright, high-contrast, accurate pictures in a bright room with shades wide open. I wanted to watch sports in the daytime without turning the house into a mausoleum. Once we weighed all of our options, we had no choice; we had to build the screen from scratch. The resulting screen turned out so good that we decided to brand it. We trademarked it UltraOnyx; descriptive because of its incredible ability to create blacks, contrast, and colors in a well-lit room. We'll be selling this innovation soon under a Runco brand name."

When asked why he elected to install a 2:76:1 screen for just a handful of movies, his initial answer was, "Because I can." But after a beat, he relayed an anecdote that revealed his true passion for all things video. "I called Gary Reber (Editor-In-Chief and Publisher of *Widescreen Review*) to ask him how to use his database to determine how many movies, and what percentage, were in 2.35: 1. While leafing through his massive 'GaryFile,' I came upon all of these other aspect ratios: 2.58:1, 2.59, 2.60, 2.70. While I knew of their existence, I did not know that they were being transferred to DVDs in their original theatrical format—it just blew me away. Ironically, after much soul-searching and conferring with my engineering staff, the *Ben-Hur*, Four-Disc Collector's Edition in 2.76:1, was released on DVD. I knew then and there that I had to have a 2.76:1 screen. As fate would have it, Lori and I were watching last year's Academy Awards®, and the president of the Academy was giving an impassioned speech about the 'unparalleled experience of seeing movies in the theatre.' Playing in the background on a very large, CinemaScope screen was *Ben-Hur* in its original aspect ratio of 2.76:1. The Academy president went on to say 'you'll never be able to experience *Ben-Hur* like this at home.' At that exact moment my wife turned to me and said, 'I don't think so.' With my 2.76:1 screen and my projector with CineWide technology, we've proven him wrong. I'll soon be sending him an invitation to visit me at my home for some popcorn and a presentation of *Ben-Hur* like he's never seen it before."

When not wowing guests with the widest home theatre image they've ever seen, the screen spends most of its time in 16:9 for TV viewing and 2.35:1 for watching his DVD collection stored on a fully loaded Kaleidescape™ DVD server system.

To achieve a seamless transition between aspect ratios, a masking system is required, but conventional masking systems take up a lot of room, and, as it was, the curved screen was already encroaching on precious living space. Runco set out to address this by engineering a new type of masking system currently under review for a patent. CineMask¸ can work with any manufacturer's screen that can be mounted on a solid substrate. With this revolutionary new masking technology, Sam's entire proscenium, including automated curtains, protrudes only two feet into the room.

Hiding all of this projection-screen wizardry is a drop-down, custom-painted canvas mural of the Runco family, depicted as a 50's family gathered around a DuMont console TV. Audio in the family room is also hidden utilizing KEF® drop-down in-ceiling loudspeakers powered by Audio Design Associates® (ADA) electronics. (Future plans call for a JBL Synthesis® loudspeaker system to be hidden in the proscenium for when the volume simply needs to be cranked.) "It's such a rush when I hit one button on my Crestron® remote and everything just pops open to reveal a beautiful CinemaScope image complete with surround sound. I've been in this industry a long time and have seen a lot of things, so for me to see and live with this level of automated technology is very exciting."

As I mentioned, Sam is an avid cook and spends much of his time in the kitchen cooking for family and friends. He wanted a way to be able to access recipes he has stored on his computer without having to place a laptop on the kitchen counter. Leave it to the Runco engineers to take a 26-inch Runco LCD and turn it into a full-blown touch screen that ties into Sam's computer so that he can browse the Internet and view recipes, call up stored recipes, or even cook and watch the Food Network at the same time. The LCD is also tied into his Crestron automation system so that he can control all the automated functions of the home. An articulating arm also allows the LCD to be viewed by family or guests sitting at the bar top.

If an outdated décor and a desire to build a bigger, better house was the fuel for remodeling his family's home, the desire for a new pool table was the match that lit the fire. Little known fact about Sam Runco: he's an avid pool player. Some might even call him a pool shark. If you amble into the popular dive-bar Gino and Carlo in San Francisco's North Beach, you'll find two pool tables in the back—nothing fancy, just your typical working-man's bar pool tables, complete with well-used pool cues. Look up and you'll notice a large plaque on the wall with the names of the past winners of the bar's annual 9-ball tournament. Among those winners you'll find his name about six times. Oh yes—he's good. So when Sam ran across a Brunswick® 1946 Anniversary table, he immediately sought approval from his wife to buy it. Lori gave a conditional "yes" under the strict edict that it had to fit their current décor. "I went crazy because all I heard was 'Yes'—I had to have this pool table no matter the obstacle. So I went to Lezlie, this is where she excels—form to function, function to form, integrating electronics, toys, games, whatever. She came back and told us we'd have to remodel the house around the table. 'DO IT!' was essentially my reply." To make the billiard room seem larger than it was so the pool table wouldn't look out of place, a custom-made 10- x 6-foot mirror was mounted to the wall. As with the mural that conceals the family room screen, nothing is as it seems in the Runco house, and a quick tap of the Crestron remote calls up the four Runco CR32 LCD TVs mounted behind the two-way mirror, each with its own independent satellite video feed. The most unusual feature, though, is not what you can see, but what you can hear and not see. So as to not intrude on the décor of the billiard room, Sam had Stealth Acoustics loudspeakers installed in the walls, then plastered over so they are completely hidden from view.

Adjacent to the billiard room, and connecting it with the kitchen, is a formal dining room with custom Shaker-style cabinets with storage for housewares on one side, and temperature-controlled wine storage on the other. He is quick to point out that the wood on the cabinets matches the wood on his pool table—not the other way around.

As of this writing, the second floor of the house is still being remodeled, and plans call for plasmas in the kids' rooms, a projector in the master, and a complete overhaul of the second-floor-dedicated home theatre.

When asked if he thinks his home is reflective more of his neighbors or of his affluent customers, Sam responds, "I know that most of the technology, well the Runco stuff anyway, is over the top but I chose those things simply because I could. The rest of the technology and the way it was integrated into our home reflect what we preach every day at Runco—that you don't need a dark, dedicated home theatre room to achieve world-class video. Our family room is a room we use every day with big windows and lots of light. I don't close my curtains every time I watch something because I don't need to. If you choose the right projector with enough horsepower, you're going to get as bright a picture as you would get with any plasma and a hell of lot bigger, too. Don't get me wrong, there's nothing wrong with plasma—we sell a lot of them, but we're trying to make people understand that they don't have to settle for the biggest plasma they can afford for their living room. We have projectors that start at $3,500 that will give you a big, bright picture on a seven-foot screen. We also have projectors starting at $10,000 that will give you the widest picture you've ever seen—just like at the movies, but better." UHD

Credits
Installer and Overall Project Manager: Anthony June, All Around Sound, Reno, Nevada
Interior Designer: Lezlie Trujillo
Runco Liaison: Mike Woods, Technical Operations Manager, Runco International, Inc.
Installer: Elan LoMonaco, All Around Sound, Reno, Nevada
Crestron Programmers: Kevin Dry
General Contractor: E. W. Rodiack & Associates, San Mateo, California
Glass and Mirrors, Capital Glass, Hayward, California
Drywall, Plaster & Stucco: Boyett Construction, Hayward, California
Kitchen, Pantry, and Wine Cabinets: Segale Brothers, Hayward California
Drapery Rods: BTX Window Automation, Dallas, Texas
Blinds: Rebarts Interiors, Burlingame, California
Draperies: American Blinds & Draperies, Hayward, California
Control Systems: Crestron Electronics, Rockleigh, New Jersey
Media Server: Kaleidescape, Mountain View, California
Audio Theatre Components: ADA, White Plains, New York
Loudspeakers: KEF, Marlboro, New Jersey and JBL, Northridge, California
Power Supply: Furman, Petaluma, California and Monster Power, Brisbane, California
Equipment Racks: Middle Atlantic Products, Riverdale, New Jersey
Cables: Monster Cable, Brisbane, California
Bronze Bannister: Olson & Co. Steel, San Leandro, California
Pool Table Refurb: Sequoia Billiard Supply, San Carlos, Dublin, San Francisco, California

About Runco International, Inc.

Founded in 1987 and currently headquartered in Union City, California, Runco International, Inc. is a market leader in state-of-the-art video projection systems, flat panel plasma monitors, video processors, and other components for the consumer market. Runco's innovations have won numerous awards and citations from the world press. Runco was the first company to introduce and market a line doubler with a multi-frequency projector in 1990 and also introduced the first multiple-aspect-ratio controller, the ARC-IV, to the Home Theatre market. Recently, both of these features have become essential for the new digital high-definition-capable televisions.

The Author

Gary Reber is the President of Ultimate Home Design, Inc. and the founding Editor-In-Chief and Publisher of *Ultimate Home Design* magazine. His diverse background in several fields includes an undergraduate, graduate, and post-graduate university education in architecture, community planning, and economic development planning. For years he was a consultant on community and economic development planning. For the past 15 years he has been an editor and publisher of magazines in the consumer electronics field. Gary can be reached at 951 676 4914 or gary@ultimatehomedesign.com.

ADVERTORIAL

More Than Just A Hurricane-Proof House

ASHEVILLE, NC—With energy costs rising to astronomical levels, homeowners are looking for any way possible to save money. North Carolina-based Deltec Homes, with their unique home design, has the answer.

Deltec specializes in building round homes, which tests have proven to be about twice as energy efficient as the conventional square or rectangular house. Circular structures require less exterior walls to enclose the living area. This allows for less energy to escape from the house. The aerodynamic nature of the circular design also helps reduce drafts throughout the home, which is one of the biggest reasons for increased energy use. "Some of the same qualities that make our homes so wind resistant also contribute to their high degree of energy efficiency," said Joseph Schlenk, Director of Sales and Marketing for Deltec Homes.

"Our design takes the round, energy-efficient design a step further," Schlenk said. "One example of this is the roof venting system, which is unique to Deltec's design."

The roof design contributes to lower energy use by allowing constant airflow throughout the year. The continuous airflow keeps hot air out of the attic in the summer, reducing the need to cool the house at the level a conventional home requires. The roof system also prevents snow and ice from building up on the roof in the winter, which further reduces heating costs.

The Deltec roof also has an overhang, which keeps out solar energy from the high summer sun and allows solar energy in during the winter when the sun is at a lower angle.

"One of the reasons why we are such believers in the Deltec system is that we used to live in a house that was approximately 1,300 square feet. Our electric bills ranged from $120 to $250 a month," Kim, a Deltec homeowner from Magnolia, Texas, said. "Our Deltec home is almost 4,000 square feet (around three times the size of our old house) and our electric bill averages around $120 to $130 per month. The Deltec home is the best construction you can find."

In addition to the effective design of the homes, the construction method Deltec uses when building homes also contributes to energy conservation. Homes are constructed panel by panel and then shipped off to the building site. Each panel is constructed so they fit together so precisely that air drafts are limited.

"We're real good at making sure that happens," Schlenk added. "We ship homes all over the world so we have to be sure the pieces fit together perfectly."

In addition to being a huge energy cost saver, Deltec homes provide numerous other benefits. Among the more important ones is the ability to withstand hurricane-level winds.

As storms battered homes in 2005, Deltec-built houses were able to fight off the winds and survive with no structural damage.

"After Hurricane Katrina we contacted all of our homeowners that were in her path," Schlenk said. "None of the homes suffered any structural damage. Any damage was limited to either minor cosmetic damage or a few missing roof shingles."

Besides the functional features that make these homes so appealing to homeowners, the houses also have an unmatched visual appeal. The unique design and flexible floor plans allow owners to build their dream home. The plentiful windows frame the spectacular views whether the house is in the mountains or on the water.

"Our design allows the homeowner to customize their home, including having windows where they want," Schlenk said. "There are not many designs that can capture a view the way a Deltec home can. When you consider all of the benefits that our design offers—high wind resistance, energy efficiency, design flexibility and overall quality, and high curb appeal—we feel that we can offer our customers the perfect home."

Looking For That Perfect Home Design?

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- Outstanding energy efficiency
- Stunning panoramic views
- High degree of design flexibility
- Resistant to hurricane-force winds
- Exceptional quality and strength

... And did we mention it's easy on the eyes, too?

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The First Optimum Performance Home™

site planning part V

Gary Reber

synopsis

- *The architectural/structural and grading/drainage submittals have been granted final approval with conditions that translate to clarifications on certain building components and material finishes.*
- *The necessary work to address the remaining architectural/structural and grading/drainage, and landscaping concerns is nearly complete.*
- *The mechanical infrastructure for the Optimum Performance Home™ is rather complex as several leading-edge technologies are employed to create the most energy-efficient design possible.*

Introduction

This is the fifth article in the series documenting the design and construction of the first Optimum Performance Home™. The project has been selected by the U.S. Green Building Council (USGBC) for inclusion in the national Leadership In Energy & Environmental Design (LEED®) for Homes pilot program, their new green build certification initiative.

The home will be built at The Sea Ranch, located in Sonoma County, along the Northern California coastline of the Pacific Ocean.

The showcase project is exemplary of the "Ultimate Home Design™" concept, which integrates age-friendly universal design with the best sustainable building practices while exerting minimal impact on the environment. Universal design is the inclusive, non-discriminatory design of products, buildings, environments, and urban infrastructure, as well as information technologies that are accessible to and useable by (almost) all. With respect to home design, the idea is to design and build homes that have no physical barriers, thus sustaining people of all ages and all capabilities in a functional, comfortable, and aesthetic lifestyle.

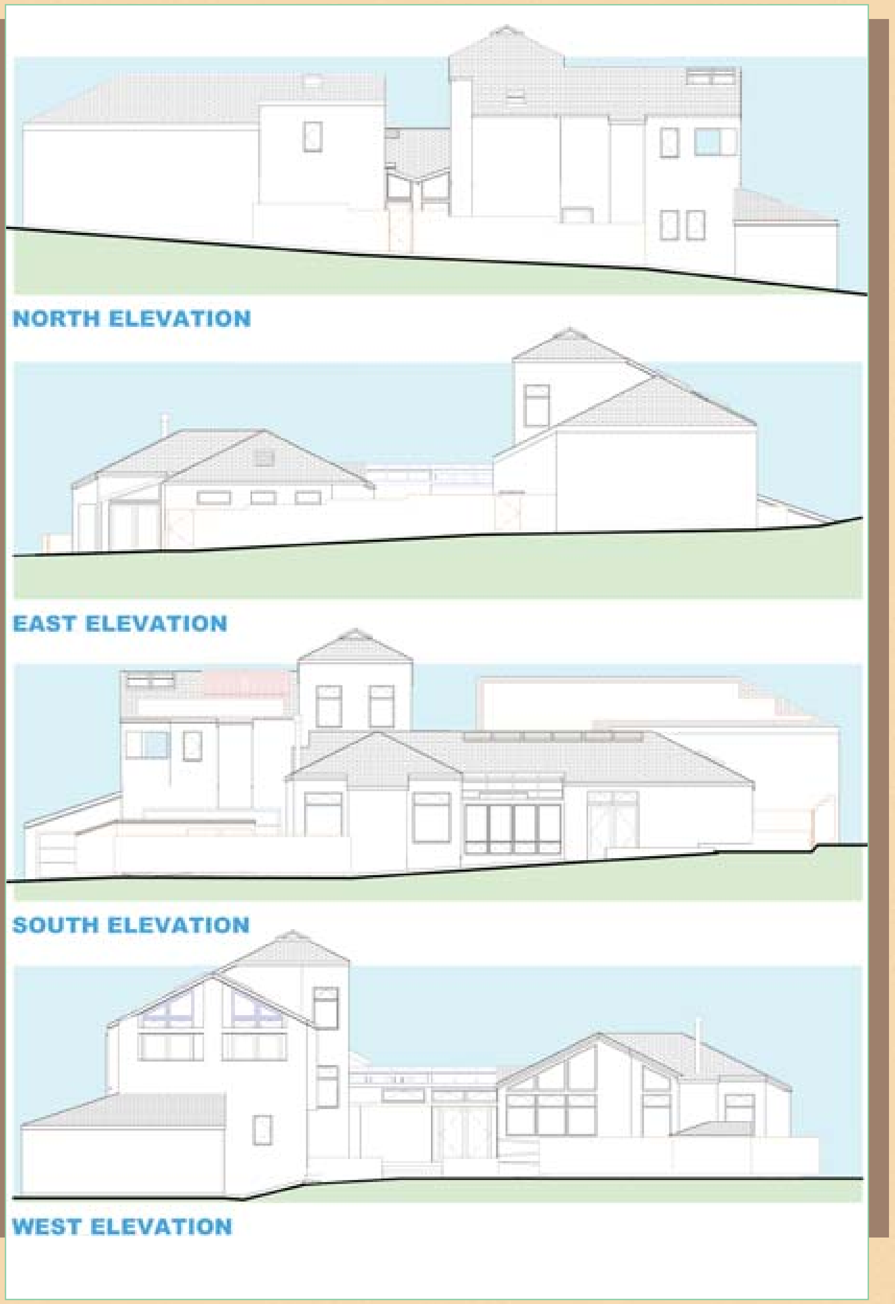
A building science systems approach to home building is the cornerstone of the project with emphasis on the relationships between the home's components and the envelope they create. Also paramount is good stewardship—proper regard and respect for the rights of neighboring homeowners, resource efficiency, and the surrounding natural setting. The goal is to optimize occupant health, comfort, and safety; maximize energy efficiency and structural durability; and minimize environmental impact. In addition, the aim is toward providing a nurturing home environment to support independent living and sustainable lifestyles.

Part I of this case study series appeared in Issue 1, January/February 2006. The introductory article extended to 16 pages and covered extensively the project scope. Part II appeared in the March/April issue and focused on site planning and preparation. Part III expanded on the approach to Low-Impact Development (LID) for the site. Part IV appeared in Issue 4, July/August, and presented the Revised and Second Revised Final plan submittal to be reviewed by the Design Committee of The Sea Ranch Association. Part of the revisions included further refinement to the site plan and drainage design, which was hopefully the final condition to be met before the project would be permitted to be submitted to the Sonoma County Building Department for final structural and code approval, necessary to obtain a building permit.

A letter, dated July 12, 2006, was received from The Sea Ranch Association Department of Design, Compliance & Environmental Management (DCEM) stating that the Revised and Second Revised Final plan submittal for the proposed home, and the associated grading/drainage and landscape plans were reviewed by the Design Committee at their May 5, May 19, and June 16, 2006 meetings. The good news is that the architectural/structural and grading/drainage submittals have been granted final approval with conditions that translate to clarifications on certain building components and material finishes. The letter stated that, "These conditions can be removed by submitting revised drawings and details for review by Design Review staff." When conditions are resolved, a letter indicating Final Approval for TSRA Construction Performance Permit will be issued for presentation to Sonoma County to obtain a county building permit. The Design Team is completing, to the satisfaction of the Design Review staff, a Third Revised Final submittal as this issue is being published.

The Sea Ranch, Sonoma County, California

> "The science of optimum performance homes is about building structures that use less energy, are quieter and more comfortable, have fewer problems with material degradation, provide clean air and water, and do less damage to the environment."



The elevations of the Optimum Performance Home at The Sea Ranch

The disappointing news is that, "The landscape plan is not approved at this time, due to a need for additional information. Specifically, the Design Committee has the following landscaping concerns, which must be addressed:

"1. There seems to be a lack of an overall concept or approach with how the landscape relates to the existing site vegetation and to the building mass. The Committee is relying on the landscaping to successfully mitigate the remaining issues with the overall size of the home. It is advised that you work with a landscape architect to develop a theme where the existing tree canopies are the base of the design, and additional like-kind species, and those of varying scales, are clustered together to create more natural-appearing formations. As you are aware, it will require careful planning and likely continual vegetation maintenance to retain solar access to rooftop PV panels.

"2. The relative graphic scale of plants shown on the landscape plan are not accurate and, therefore, not representative of the actual buffering capabilities of the plant form.

"3. Plants should be pulled closer to the edges of the perimeter building walls to have a more effective relationship in lowering the building mass.

"4. All new planting shall be installed with protective deer screens and a drip irrigation system to promote survival.

"5. Overlap tree canopies around driveway to better obstruct view up driveway toward house from road.

"6. Specify all planting intentions at planter beds as indicated on Sheet L-2.

"7. Distinguish existing vegetation to remain and any existing trees to be removed from proposed plantings on the Landscape Plan.

"8. All plans should have a north arrow for orientation purposes.

"9. South facade needs tree plantings for visual screening (as implied on elevation drawing, Sheet L-3). Species indicated on plan are of inappropriate scale.

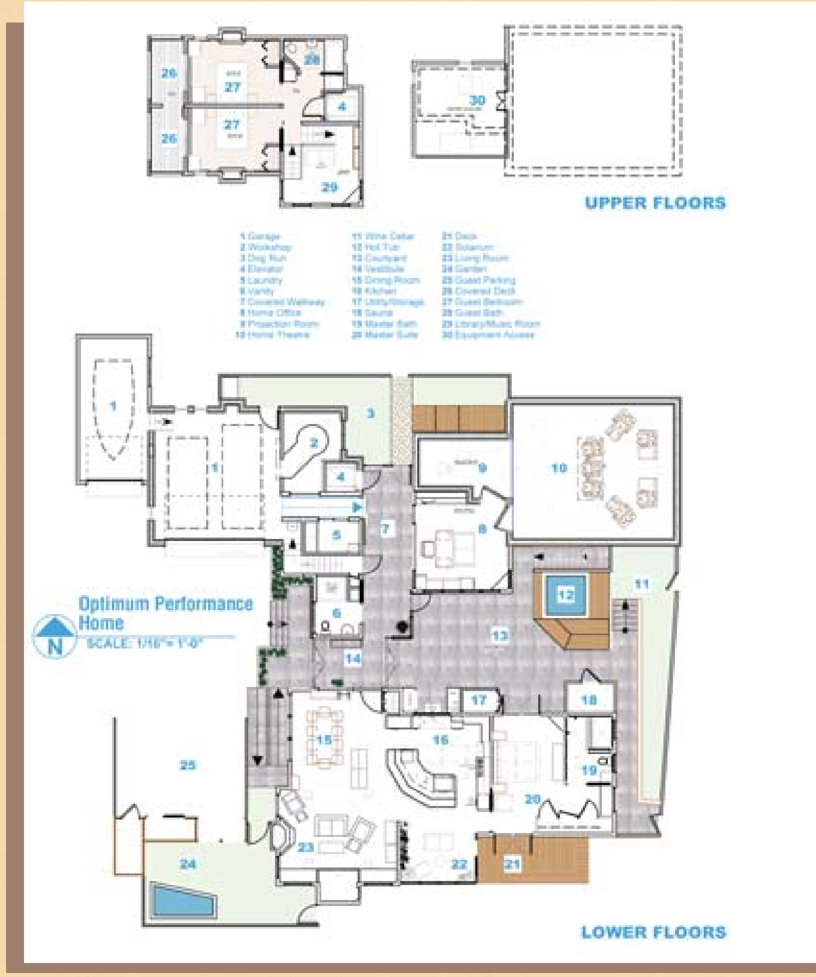
"10. Add erosion-control ground-cover plantings on cut-slope areas.

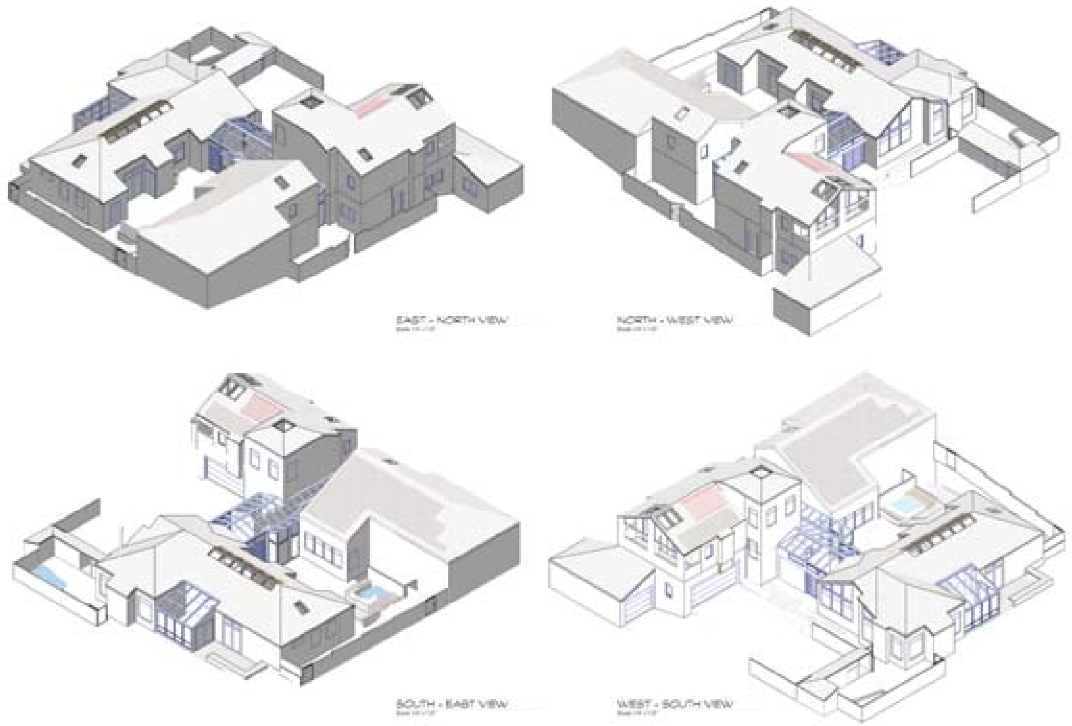
"11. Ensure that native plant species selected are suitable for damp/wet soil conditions.

"12. Refer to plan mark-ups for possible additional issues not specifically itemized within this letter.

"A revised landscaping submittal will be required to address these issues. The Committee will allow the landscaping issues to be resolved independent of the building/grading issues in order to avoid further delay to the issuance of permits/commencement of construction."

Much of the concerns stated are subject to interpretation and have been fully addressed in the landscape plan submittal. If the Design Team could have been at the Design Committee meetings to discuss our proposals, we could have had a productive dialogue in which we could have provided further clarification of the plans submitted, provided reference documentation on plant species and their scale, and explained our design approach, which fully subscribes to the approved Sea Ranch Association Vegetation Management Plan, including adhering to selecting the allowable plant species designated specifically in this plan in accordance with the site's





Four perspective views of the Optimum Performance Home at The Sea Ranch

SOUTHWEST VIEW

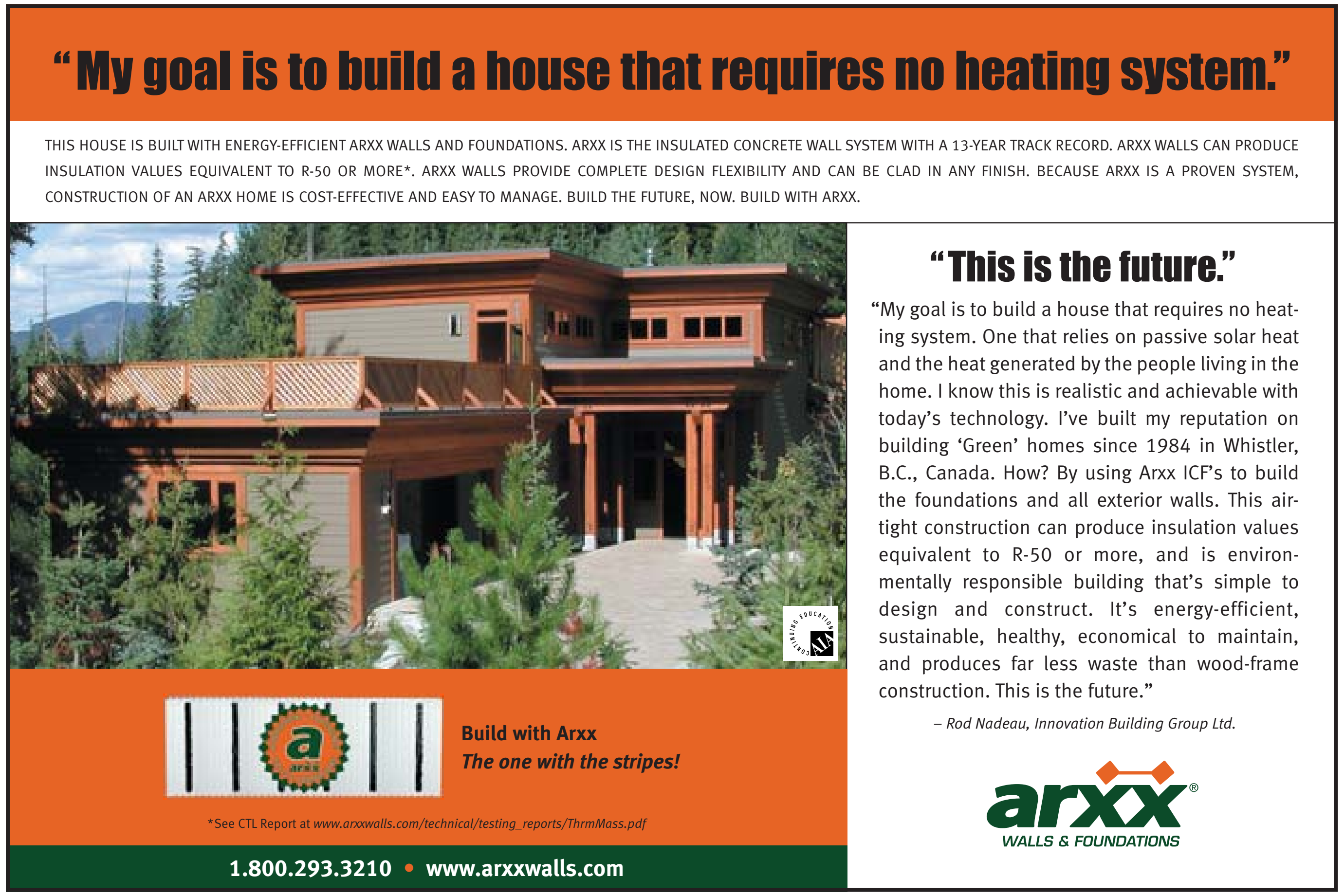
A perspective of the southwest view created by architectural designer Ed Rose.

environmental conditions. And the Design Committee would have had the opportunity to educate us about their viewpoint and desires so that we could more effectively interact with them.

There has been so much wasted time, effort, and money that has occurred in the Design Committee process with respect to this proposed project. Fully, three years, nine months have passed since the first site review and conceptual plan stage of the project. While this "approval" letter is dated July 12, a full four weeks preceded the actual date of Design Committee approval on June 16. In our Design Team's experience, there is so much misunderstanding that comes from the exclusion of the property owner and design representatives. And as a result, there is so much needless pain and frustration, not to mention the escalating professional design and construction costs that are the result of the dragged-out design review process.

In any event, the Design Team is re-addressing with more clarification the concerns expressed and providing the additional information requested.

The necessary work to address the remaining architectural/structural, grading/drainage, and landscaping concerns expressed in the July 12 letter is nearly complete. This work includes the structural and mechanical plans for the Optimum Performance Home, necessary



For more information on this advertiser, circle 09

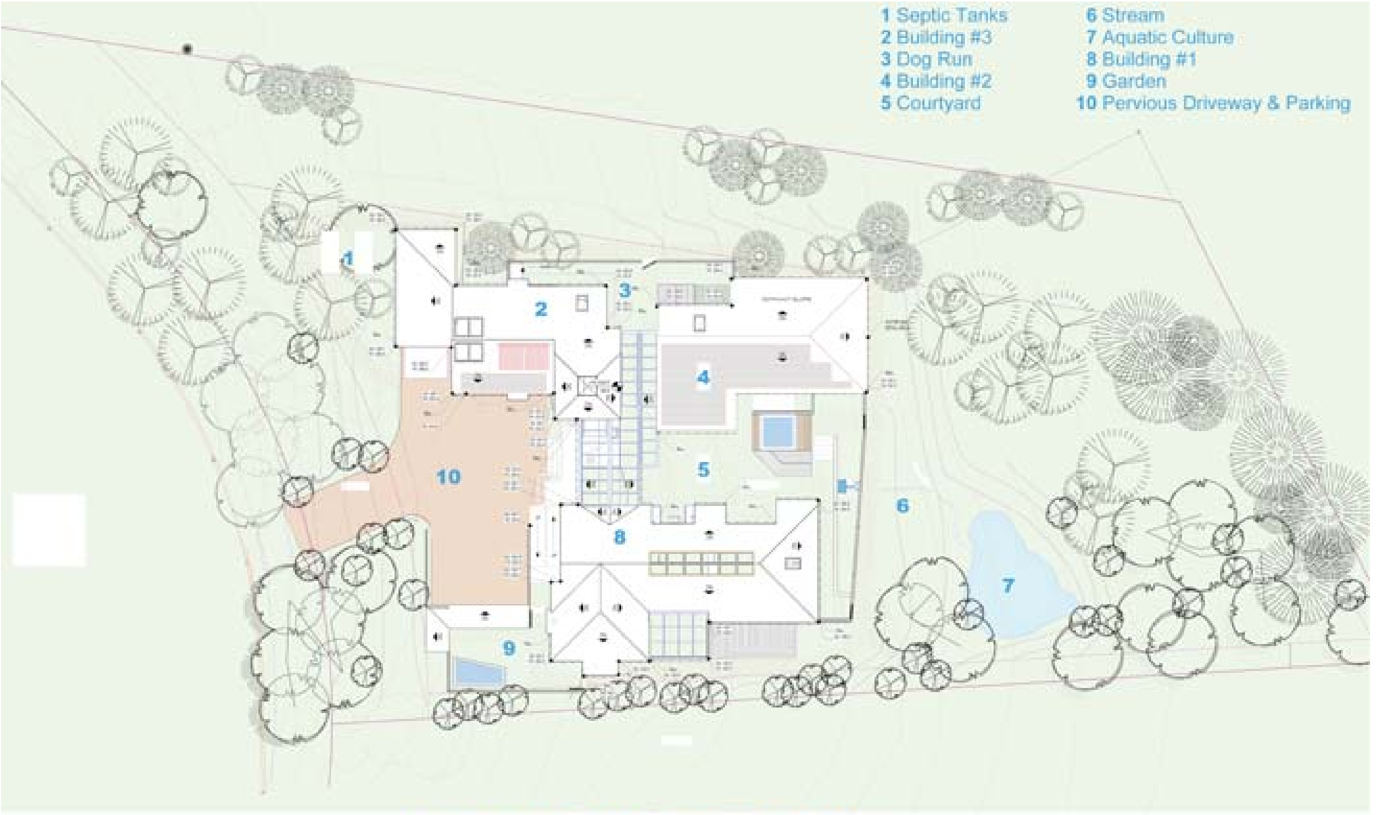
as part of the plan submittal to Sonoma County.

Assuming that Sonoma County and The Sea Ranch Association's DCEM will not further delay the issuance of permits, the commencement of construction, site-grading, foundation, and mechanical infrastructure could start by mid-October 2006.

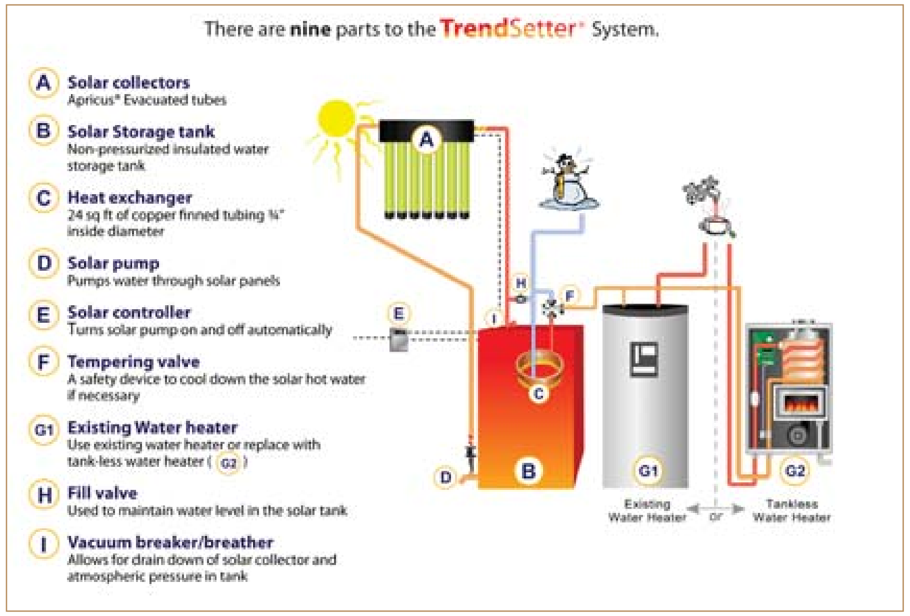
In this, Part V of the case study series, the focus will be on the mechanical infrastructure planned for the Optimum Performance Home.

Mechanical Infrastructure

As noted in the previous articles in this series, the home design integrates all of the concepts advocated in *Ultimate Home Design*™. The goal is to demonstrate how today's products and

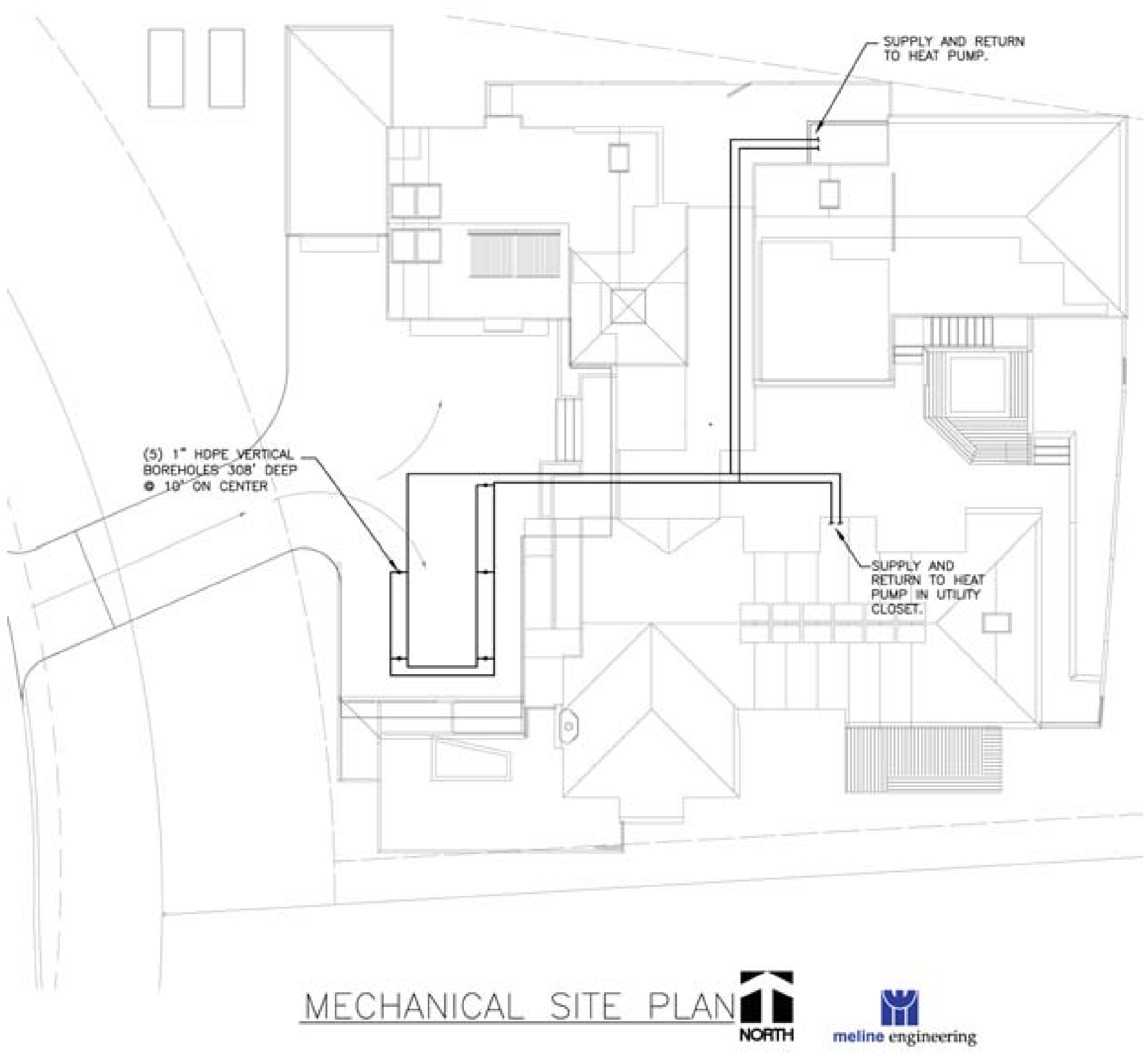


LANDSCAPE/SITE PLAN



building methods can make life safer, more comfortable, and more enjoyable. The science of optimum performance homes is about building structures that use less energy, are quieter and more comfortable, have fewer problems with material degradation, provide clean air and water, and do less damage to the environment. As an integrated holistic design, the house will serve as a home for many people and serve in many phases in one's life.

The Optimum Performance Home's site plan is designed to strongly support the efficient use of the community's water supplies, equitable allocation of water resources provided by the

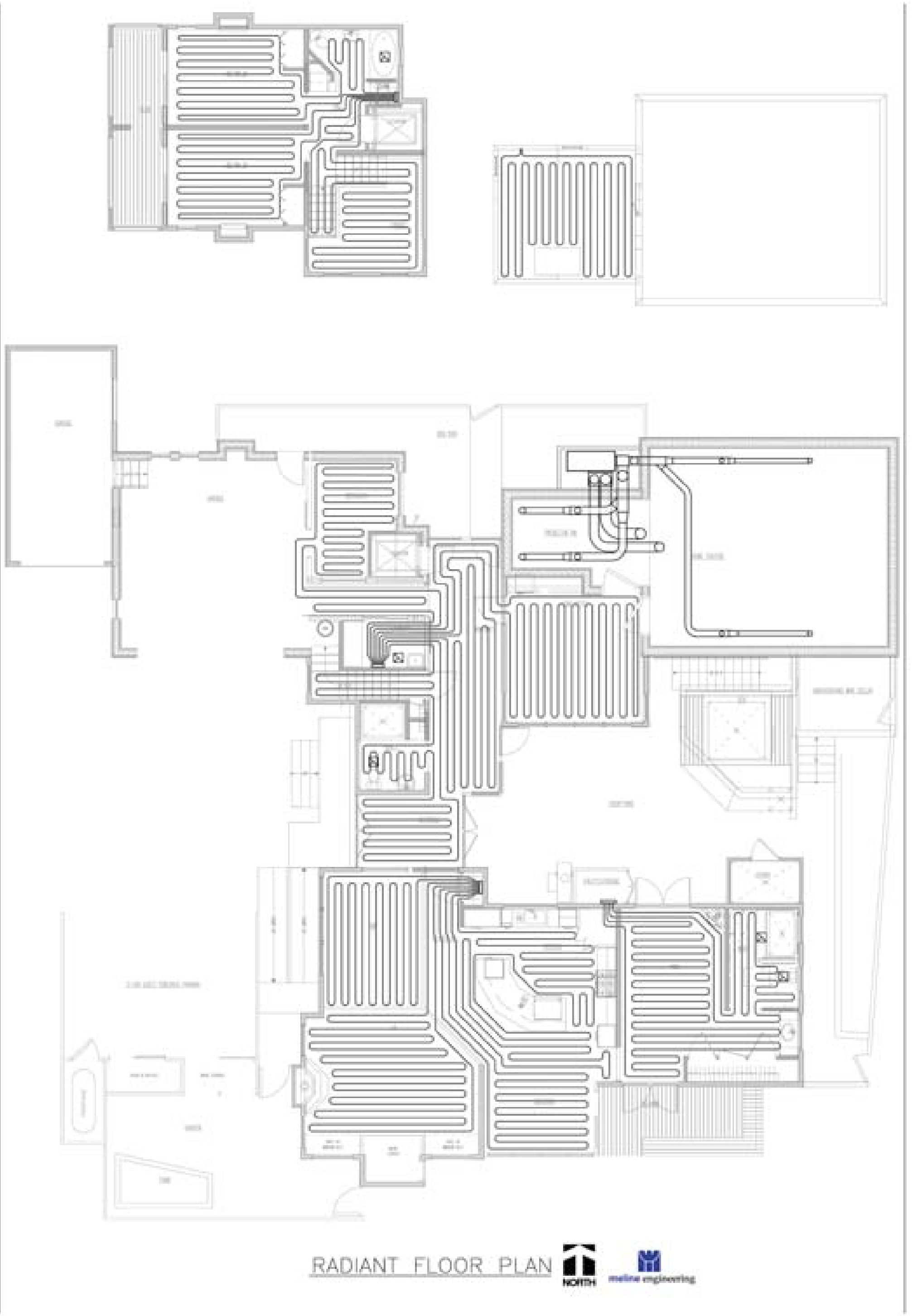


community and harvested on-site, elimination of water pollution and contamination from poorly-designed or failing septic systems, and general land use patterns that conserve and protect water resources within the overall ecosystem at The Sea Ranch. The water-efficient site plan and drainage design promotes "smart water use."

The mechanical infrastructure for the Optimum Performance Home employs several leading-edge technologies to create the most energy-efficient design possible. The home is designed to cut its energy use with efficiency, and then meet the remaining needs with renewable energy sources.

This includes on-site energy generation in the form of a 4.4-kilowatt (kW) MyGen™ Meridian® photovoltaic (PV) roof-integrated solar panel system by Kyocera Solar, Inc., operated and managed using a GridPoint™ Connect Series hub for the renewable system's connection to the Pacific Gas & Electric (PG&E) utility grid and for online Internet energy management. This installation will be capable of generating near-zero energy home (ZEH) cost operation, if not zero-energy home cost, for the electricity use in the home. The ZEH design is based on the Solar Buildings Program of the U.S. Department of Energy.

Net metering allows the electric meter to spin backward and forward, meaning



that at times the home will pull (and pay for) power from the electric grid, and at other times it will produce more energy than it will need, with the excess being sold to the electric company, resulting in an annual net-zero energy cost. It is expected that the home will generate more electricity than it uses. The GridPoint intelligent management system is designed to continue providing electricity even during blackouts.

Solar hot water preheating will be provided by TrendSetter® Industries, Inc. using two AP-30 Apricus® Solar Collectors. A ground-coupled heat pump will be system-integrated to maintain the domestic hot water temperature for the main house and laundry. A 200-gallon

Kyocera Solar MyGen™ Meridian® Roof-Integrated Solar Electric Generation System

• The high-efficiency d.Blue MyGen Meridian solar system visually blends with the Optimum Performance Home's architecture and black slate roofing, becoming an energy-producing enhancement. Kyocera backs the easy-maintenance cassette system with a 25-year limited warranty on power output. The system is Class A fire rated for all roof pitches.

Gridpoint™ Connect Series

• The GridPoint Connect Series is the first appliance to intelligently manage renewable energy and provide instant backup power. The unit seamlessly combines power electronics, high-capacity battery storage, and an Intel® Pentium®-based computer. The appliance actively communicates with GridPoint's network operations center to ensure optimal performance. The result is reliable power in the event of an outage and an intelligent and automatic way to monitor solar electric use.

TrendSetter® Industries' AP-30 Apricus® Evacuated Solar Tube Collectors & Solar Thermal Storage Tank

• TrendSetter solar tube systems reduce the water heating portion of a utility bill by as much as 90 percent. The composite aluminum tank features a seamless high-temperature EDPM lining, all-copper/cupro-nickel fittings, rigid foam insulation, stainless-steel fasteners, and silver-brazed joints, and is warranted for 20 years with an indefinite life expectancy.

Spunstrand® Filament Wound Fiberglass Underslab Duct

• Spunstrand air-conditioning duct is designed for direct burial applications and manufactured using the filament wound method to provide the greatest strength.

TS-200 TrendSetter Solar Thermal Storage Tank will supply preheated water. The weather resilient tank will be buried outdoors under the courtyard. TrendSetter solar hot water systems are unique in their scalability from 100 to 1,200 gallons of storage; they are up to ten times more efficient than other systems.

A Takagi T-H1 ENERGY STAR®-qualified on-demand instantaneous tankless water heating system will be used for the guest area above the garage in Building 3 of the three-building compound with a Takagi T-K Jr. providing on-demand hot water at the outdoor shower sourced from harvested and filtered rainwater.

Geothermal energy will be harnessed with a ground-coupled vertical closed-loop system designed by Meline Engineering, which circulates water from the earth to extended range water source heat pumps manufactured by WaterFurnace International, Inc. An EW Series water-to-water heat pump will be used for the whole-home zoned radiant floor heating system. An E Series water-to-air heat pump will provide air conditioning to the dedicated home theatre and projection room in Building 2. The WaterFurnace system also will serve as a back-up domestic hot water source.

The WaterFurnace closed-loop system circulates water through a "loop" of small-diameter, underground pipes made of high-density polyethylene. Closed-loop systems can be installed either horizontally or vertically, or even in a pond. In the case of the Optimum Performance Home, the system will be installed vertically under the guest parking area. The ground-loop portion of the geoexchange system uses the constant temperature of the earth as a heat source instead of natural gas or propane for increasing the efficiency of an electric ground-coupled heat pump. The ground loop replaces the "outdoor unit" of a conventional air-to-air heat pump.

Spunstrand special underslab low-velocity insulated ducts for ultra air flow quietness will channel the air-conditioning to the dedicated home theatre and projection room.

The AQUAPEX® PEX radiant floor heating, AQUAPEX PEX plumbing, and AQUAPEX PEX fire sprinkler system to be installed in the Optimum Performance Home are designed and manufactured by Uponor. PEX is cross-linked polyethylene. PEX flexibility and strength at temperatures ranging

from below freezing up to 200-degrees Fahrenheit makes it an ideal piping material for hot and cold water plumbing systems, trouble-free firesprinkler systems, and hydronic radiant floor heating systems.

As part of the Uponor PEX plumbing system, an Aquacore® Whole Home Ultra Filtration System and a Sylvan Source M-600 Ultra-Clean Water System will be integrated. The Aquacore ultrafiltration system produces an uninterrupted stream of bottled-quality drinking water to every tap in the home. The unit processes water at the rate of 10 gallons per minute using a patented multi-bore hollow fiber membrane design with seven capillaries in every fiber. Thousands of membrane strands have billions of .02 micron pores that act as a strainer to filter out particles, turbidity, and pathogens, including bacteria, viruses, and cysts, while allowing water to flow through with virtually no pressure drop. The process does not add chemicals to the household water and improves the performance of other water treatment equipment in the home.

A Sylvan Source M-600 will further purify the ultrafiltered water produced by the Aquacore system and serve as the ultrapure water source for ice makers, refrigerators, and kitchen faucets.

The mechanical system design will include a whole-home Broan SmartSense Ventilation System equipped with ENERGY STAR-qualified Ultra Silent Series QTXE fans and spot-specific QTXE Ultra Silent Sensing fans and fans/lights in the bathrooms, laundry room, and garages. The SmartSense Ventilation System performs as an energy recovery ventilation (ERV) system to provide fresh air while exhausting stale air and filtering dust and indoor air pollutants. The Broan system operates automatically and employs patent-pending sensing technology to regulate the volume of fresh air ventilation and maintain a constant humidity level in the home.

A dedicated ENERGY STAR-qualified Panasonic WhisperComfort™ ceiling-mounted spot ERV fan will be used in the home theatre to provide fresh air while exhausting stale air.

Title 24 documentation is being provided by Sol Data based in Santa Rosa, California. Their load calculations will be used to coordinate equipment selections for overall home compliance with the 2005 California Building Energy Efficiency Standards.

Propane gas will be used as the source for two gas-operated cooking appliances: an ENERGY STAR-qualified KitchenAid® Architect Series®

Takagi T-H1 ENERGY STAR®-Qualified Tankless Water Heater

• The Takagi T-H1 provides a never-ending supply of 120-degree Fahrenheit water in the most efficient way possible.

WaterFurnace EW & E Series Heat Pumps

• The Optimum Performance Home™ will use a WaterFurnace EW Series heat pump to boost the solar hot water temperature (as needed) for both the whole-home radiant floor heating and domestic hot water heating systems. An E Series water-to-air heat pump will be used to provide air conditioning to the home theatre and projection room.

Sylvan Source Ultra Clean Water System

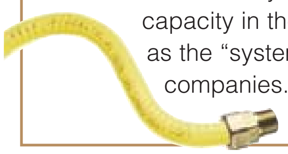
• Sylvan Source unique multi-stage technology features breakthrough four-stage water processing consisting of degassing, distillation, demisting, and condensing. The system requires no filters, cartridges, membranes, or chemicals and features a patent-pending self-cleaning process. The rugged, stainless-steel construction and industry-standard plumbing connections assure long-term durability.

Aquacore® Whole-Home Hollow-Fiber Ultrafiltration System

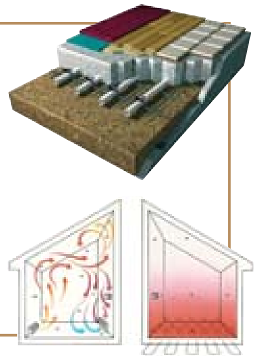
• The Aquacore point-of-entry ultrafiltration system is capable of producing a steady flow of microbiologically pure water throughout the home.

Wardflex® Flexible Fuel Gas Tubing

• Wardflex® is the gas piping system for the 21st Century with the highest overall rated flow capacity in the industry. Wardflex is recognized as the "system of choice" by major gas utility companies.



Uponor® Radiant Floors



• Warm water circulates under the floors throughout the Optimum Performance Home™ using Uponor's durable, flexible, and resilient crosslinked polyethylene AQUAPEX tubing, providing a comfortable, even heat without stirring up dust and pollutants.

Uponor® AQUAPEX® Plumbing System

• AQUAPEX tubing is clean, does not corrode, and is not affected by corrosive water and soil. In addition to being a healthier way to move water through the Optimum Performance Home™, it is also quiet, durable, virtually maintenance free, and guaranteed for 25 years.

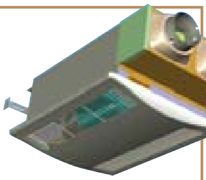
Uponor® Fire Protection System

• Uponor's reliable and trouble-free fire sprinkler system is designed for fast response. The AQUAPEX plumbing system provides water to the sprinkler fixtures, which activate independently when temperatures reach 150-degrees Fahrenheit. The system exceeds the National Fire Protection Association (NFPA) requirements.

Broan® Ultra Silent Sensing Fan

• The ENERGY STAR®-qualified Boran Ultra Silent Series QTXE fans and fan/lights are the quietest fans in the industry and provide occupant-sensor technology to assure needed ventilation.

Panasonic WhisperComfort™ Ceiling-Mounted Spot ERV



• The ENERGY STAR®-qualified WhisperComfort fan provides whole-home fresh air ventilation with its energy recovery ventilation (ERV) core technology. The ERV unit delivers fresh air while exhausting stale air and filtering out dust and indoor air pollutants.

KDRP767R dual-fuel 36-inch-wide range with steam-assist will be the primary cooking appliance and a professional AGM36 manually controlled 36-wide griddle manufactured by Wolf Range Company will serve as an exhibition Japanese Teppan-Yaki cooktop. These two appliances will be supplied propane gas using Wardflex® flexible corrugated stainless-steel fuel gas tubing. A Broan® professional ISER222SS 51.5-inch wide stainless-steel island hood rated at 1000 CFM will provide exhaust for the AGM36, and a Broan professional KER22242SS 42-inch wide stainless-steel wall hood rated at 1000 CFM will provide exhaust for the KDRP767R. The controls for both hoods are operable via remote control to support the universal design requirements of the Optimum Performance Home.

Lisa Meline of Meline Engineering, based in Sacramento, California, is the mechanical engineer on the Design Team. The plumbing contractor, experienced in radiant floor heating and PEX plumbing, is Rick O'Neil of Tom's Plumbing in Gualala, California, just north across the Gualala River from The Sea Ranch. Mike Ericksen and Mark and Beth Morelli of Air Connection in Santa Rosa, California will provide the installation of the WaterFurnace geothermal system.

The article, which follows, is written by Lisa Meline with a focus on the mechanical engineer's role on the Design Team. An article written by Norm Ehrlich, Founder and Chief Technical Officer of TrendSetter Industries, Inc., appears elsewhere in this issue and covers the selection and application of solar water heating systems.

Next

As stated previously in past articles, the design review process itself has no doubt weighed us down over this unexpectedly long period of time. But, now that the Design Committee has granted essentially final approval, though with conditions that pose no insurmountable challenges, the project should now move forward in a hastened manner, so that commencement of construction can begin by mid-October. The next series of articles will focus on each stage of construction and the design approach taken, and the technologies and building systems and materials used to create the first Optimum Performance Home. UHD

The Mechanical Engineer's Role

Lisa Meline, PE

Energy Management

The mechanical engineering professional is an important player on the custom home design team. Mechanical engineering is at the crossroads of all engineering disciplines, with formal education in topics also covered by electrical, civil, and structural engineering programs. Many mechanical engineers also have had basic courses in controls, acoustics, and environmental topics.

The core of the mechanical engineer's value on a custom home design team is his or her role in managing energy: solar, electricity, petroleum-based products, and sometimes wind. The mechanical engineer must be familiar with the standard building codes in the state in which he or she is licensed. For example, I am licensed in California and must be familiar with California's Building Energy Efficiency Standards, which were recently updated to be more restrictive, especially in the residential arena. By code, the mechanical engineer is one of several design professionals required to specify the energy efficiency of the home building materials, lighting, and mechanical systems. He or she must also maintain the aesthetics required of the custom home designer and the comfort desired by the owner.

The innovation and technology in the custom home industry has become more complex. There are new building materials that must be modeled for their heat transfer characteristics. Because homes are built "tighter" than in the past, this introduces a new challenge in mechanical system design, which is to provide the necessary ventilation of fresh air. Good ventilation improves indoor air quality and can mitigate issues with mold.

Many of the high-end homes are moving toward total home control or smart home controls, as is the case with the first Optimum Performance Home™ at The Sea Ranch. This type of system can control anything from the security system and lighting to the volume of built-in sound and video systems, inside and out.

All of these design elements need to be coordinated with the mechanical engineer. On the design team, the mechanical engineer is usually responsible for the plumbing system design; heating, ventilation, and air-conditioning (HVAC) design, sequence of operation for the control system design; and, in most cases, the energy calculations, which show compliance with the Building Energy Efficiency Standards (often called, in California, Title 24 documents). The mechanical engineer creates his or her system design with input from other specialty professionals on the custom home design team, such as the home theatre designer, humidor and wine cellar consultants, kitchen designers, and pool and spa builders. The mechanical engineer also coordinates the mechanical equipment requirements with the electrical engineer to make sure that the electric service to the home is of the proper size. The dividing line between the civil engineer and the mechanical engineer relative to the plumbing design is usually drawn at a five-foot perimeter around the house. The mechanical engineer determines the sewer, water, and gas (if applicable) requirements of the home and coordinates this with the civil engineer to ensure that the proper size and capacity of the utilities are brought on site and the proper connections are provided for the home. Because of the open space of some custom home designs and often the home's geographic location in anticipated seismic activity zones, piping and plumbing within a custom home can often be a challenge to the integration of a duct distribution system.

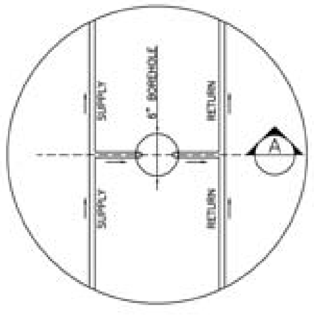
Geothermal Energy Use In The Optimum Performance Home™

For this particular design of the Optimum Performance Home at The Sea Ranch, a geoexchange system manufactured by WaterFurnace International, Inc. was chosen as the means for heating and air conditioning. The system (also commonly referred to as a ground-source heat pump system or geothermal heat pump system) consists of three main components—the heat pump, which is the foundation of the system (manufactured by WaterFurnace International); a closed-loop vertical "well" system, which is drilled into the constant temperature earth on site; and water, which is circulated between the ground loop and the heat pump in high-density polyethylene pipe. The ground-loop portion of the geoexchange system uses the constant temperature of the earth as a heat source instead of natural gas or propane for increasing the efficiency of an electric ground-coupled heat pump. A heat pump can provide both heating and cooling, and it operates on the

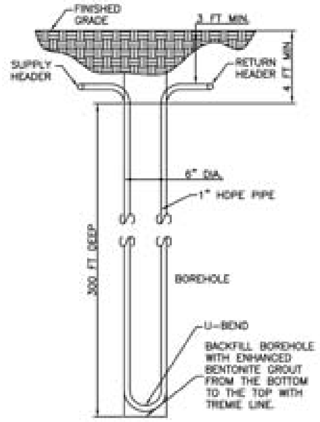
Shown is a typical water-to-water heat pump installation for a radiant floor system.
The hot water heater to the left is used as a buffer tank for the radiant floor system.

same type of refrigeration cycles as conventional HVAC equipment. The difference is that the ground-coupled heat pump can take 1 kilowatt (kW) of electricity and turn it into 3 to 4 kW of heating energy for the home. This rating is called the coefficient of performance (COP), and for geoexchange systems, the performance is usually between 3 and 4 COP. On the Optimum Performance Home project, the water-to-water ground-coupled heat pumps will be making hot water to be distributed through the home in a radiant floor distribution system manufactured by Uponor. All of the rooms except the home theatre and the projection room will have radiant floor heating. The home theatre and the projection room will be heated and cooled with a two-zone water-to-air ground-coupled heat pump. This type of system was selected for the home theatre and projection room because it is expected that more continuous cooling will be required to offset the heat created by the home theatre projection and audio equipment. Both of these heat pumps will be connected to a single ground-loop system. The ground-loop system will allow the heat pumps to operate in heating and cooling modes simultaneously.

The mechanical engineer will be responsible for selecting the mechanical equipment, designing the radiant floor and duct distribution systems, and providing basic control sequences for the builder. The mechanical engineer is also responsible for sizing the ground loop. The ground-loop piping will be buried between 3- and 4-feet below finished grade in the guest parking area. It will be a series of vertical 1-inch diameter high-density polyethylene tubing drilled down into the earth to 250- to 300-feet deep placed at roughly 10- to 15-foot centers. Water will be circulated within this 1-inch diameter high-density polyethylene closed-loop pipe to transfer heat from the earth to the heat pumps in the house. In cooling mode, the water will be circulated between the heat pumps in the house and the earth, to reject heat back into the earth. If both units are operating simultaneously, the heat rejected from the water-to-air heat pump in the home theatre (cooling) will be transferred directly to the water-to-air heat pump, making hot water for the radiant floor.



GEOTHERMAL BOREHOLE
SCALE: NONE



A GEOTHERMAL BOREHOLE SECTION
SCALE: NONE

In addition to being energy efficient, the ground-loop portion of the geoexchange system is all below ground and out-of-sight. Essentially, the ground loop replaces the "outdoor unit" of a conventional air-to-air heat pump. There is no noisy equipment outside the home to detract from the beautiful Sea Ranch setting of this Optimum Performance Home.

The geoexchange system will also be used as a backup-heating source for the domestic hot water system. The solar thermal system designed by TrendSetter Industries, Inc. will be heating water and storing it in a large tank buried outside the home beneath the courtyard. On days where the energy from the sun cannot be used, the geoexchange system will be engaged to maintain the hot water temperature in the solar hot water storage tank. This ensures that when additional energy is required to heat the hot water it will operate at a COP of about 3 rather than a COP of 1, which is the efficiency of an electric resistance hot water heater.

The challenges of integrating this system into the Optimum Performance Home will lay mainly in interfacing with other trades on the project. The installation of the ground-loop system will need to be coordinated with the site development work. A drilling permit is usually required in addition to a construction permit for the ground loop portion of the geoexchange system. The spoils resulting from the drilling process will need to be contained and, in some cases, hauled off the project site.

Since the geoexchange system is essentially a "central plant" system, there will need to be integration with many of the systems in the home. Careful coordination will be required between the contractors providing the radiant floor system, sheet metal and underslab ductwork, plumbing, controls, and solar system.

Because of the high level of coordination and unfamiliarity of many trades with the geoexchange system, a contractor certified by the International Ground Source Heat Pump Association (IGSHPA) will install the system at the Optimum Performance Home site. The entire system will be commissioned by the engineer of record. It is very important that the system performance be verified to ensure its energy efficiency in accordance with California Title 24 documents. UHD

The Authors

Gary Reber is the President of Ultimate Home Design, Inc. and the founding Editor-In-Chief and Publisher of *Ultimate Home Design* magazine. His diverse background in several fields includes an undergraduate, graduate, and postgraduate university education in architecture, community planning, and economic development planning. For years he was a consultant on community and economic development planning. For the past 15 years he has been an editor and publisher of magazines in the consumer electronics field. Gary can be reached at 951 676 4914 or gary@ultimatehomedesign.com.

Lisa Meline, P.E., is the principal engineer and owner of Meline Engineering. She has 17 years of mechanical engineering experience and over 22 years of experience in the construction industry. Ms. Meline has a strong background in project and construction management and design engineering. She has prepared HVAC and plumbing designs for commercial, educational, industrial, residential, and government buildings throughout California, Nevada, and Colorado. Ms. Meline is a LEED Accredited Professional and a Certified Geoexchange Designer by the Association of Energy Engineers. She is a voting member of ASHRAE TC6.8, the Technical Committee on Geothermal Energy Utilization and holds memberships with ASME, ASHRAE, AEE, GHPC and IGSHPA. Ms. Meline is the Chair of the Industry Advisory Council for California State University Sacramento and is a recipient of ASME's Distinguished Service Award. More recently, Meline Engineering was nominated and was a finalist for the Sacramento Workplace Excellence Leadership Award (SWEL) in the Small For-Profit category .Meline Engineering is located at 9216 Kiefer Boulevard, Suite 6, Sacramento, CA 95826. Lisa can be reached at 916 366 3458 or lisa@meline.com.

Acknowledgements

Ed Rose is a residential architectural designer. His company is Rosebud Studios based in Monte Rio, California. Ed has been designing homes and remodels on The Sea Ranch and surrounding areas since the late 1980s. His skill in listening to and understanding his client's architectural program and then translating that into a workable and pleasing design acceptable to the rigorous philosophy of The Sea Ranch Design Committee is responsible for the final successful approval of the First Optimum Performance Home™ at The Sea Ranch. This included the fairly new design concepts of universal access and aging-in-place, use of "green" materials, and meeting the exacting guidelines for a residential LEED® certification. It wasn't until Ed joined our team that we began to make progress with the Design Committee in this challenging process. Ed provided all of the images of the site plan, floor plans, elevations, and isometric perspectives for the magazine. His extensive education and experience span numerous disciplines from architecture to industrial and graphic design to technical illustration, photography, and painting. Ed can be reached at 707 865 1146 or 707 785 9180 or rosebud@thegrid.net.

Bill Wilson is an environmental consultant with over 35 years experience working internationally in the field of comprehensive sustainable development, with emphasis in the areas of agriculture, building systems, energy, watershed planning, wastewater treatment and reuse, aquaculture, and marine systems. He holds a degree in Environmental Studies, with concentrations in Aquatic Biology and Political Science, from the University of California, Santa Barbara, and is a graduate of the Special Program in Landscape Architecture, Harvard University Graduate School of Design. Bill Wilson Environmental Planning, LLC is based in Mill Valley, California. His firm planned the water systems for the first two LEED platinum-rated buildings in California, and he is on the LEED Technical Advisory Committee for the U.S. Green Building Council. He is the Editorial Director of the Environmental Design Department of *Ultimate Home Design*. Bill can be reached at 415 383 2919 or on his mobile phone at 805 689 7639 or by e-mail at billwilsonwater@earthlink.net.

Architectural Illustration & Photo Credits

Ronald Devesa is an architectural illustrator, based in Santa Rosa, California. He specializes in architectural rendering and CAD drafting using AutoCAD, Autodesk VIZ-Maxwell, and Photoshop. He is a member of the American Society of Architectural Illustrators. Samples of his work can be viewed at www.geocities.com/rldevesa. Ronald can be reached at 707 849 3500 or rldevesa@sbcglobal.net.

Scott Simpson is a pilot and aerial photographer. His company is West Of One, based in Gualala, California. Scott resides at The Sea Ranch and provided the aerial photos depicted in this article. Samples of his work can be viewed at www.westofone.com. Scott can be reached at 707 785 9445 or scott@westofone.com.

Product Information

- Aquacore by Aquest, Inc., 604 East North Street, Elburn, Illinois 60119, 630 365 2525, www.aquacore.com
- Broan-NuTone, 926 West State Street, Hartford, Wisconsin 53027, 800 548 0790, www.broan.com
- GridPoint, Inc., 2020 K Street NW, Suite 550, Washington, DC 20006, 202 903 2100, www.gridpoint.com
- Kyocera Solar, Inc., 7812 East Acoma Drive, Scottsdale, Arizona, 85260, 480 948 8003, www.kyocerasolar.com
- Panasonic Home & Entertainment Company, One Panasonic Way, Secaucus, New Jersey 07094, 866 292 7292, www.us.panasonic.com
- Spunstrand Incorporated, 620 North Post Street, Post Falls, Idaho 83854, 208 665 7444, www.spunstrand.com
- Sylvan Source, 285 North Wolfe Road, Suite 103, Sunnyvale, California 94085, 408 736 7186, www.sylvansource.com
- Takagi Tankless Water Heaters, 5 Whatney, Irvine, California 92618, 888 882 5244, 949 770 7171, www.takagi.com
- TrendSetter Industries, 1385 8th Street, Arcata, California 95521, 800 492 9276, www.trendsetterindustries.com
- Uponor North America, 5925 148th Street West, Apple Valley, Minnesota 55124, 2 997 5329, www.uponor-usa.com
- Wardflex® by Ward Manufacturing, Inc., P.O. Box 9, Blossburg, Pennsylvania 16912, 800 248 1027. 570 638 2131, www.wardflex.com
- WaterFurnance International, Inc., 9000 Conservation Way, Fort Wayne, Indiana 46809, 800 222 5667, www.waterfurnace.com

Mechanical Equipment Installers

- WaterFurnace Equipment—Air Connection, 395 Irwin Lane, Santa Rosa, California 95401, 707 571 8384, www.acconnections.com
- Uponor Radiant Floors & AQUAPEX Plumbing—Tom's Plumbing, Inc., P.O. Box 92, Gualala, California 95445, 707 884 3818, tpinc@mcn.org

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Solar Water Heating... A Sure Bet

Norm Ehrlich

synopsis

- *Percentages of total energy consumed annually by an average household for hot water range from 25 percent to as much as 40 percent.*
- *Sizing a solar water heating system as part of an overall energy strategy for a new home is more of an art than a science.*
- *Replacing a standard tank-type water heater with a "tankless" water heater is a step in the right direction, although it is no substitute for solar water heating.*
- *The concept of solar water heating is to heat the water before it enters the gas-fired water heater, whether it be a tank or tankless water heater.*

Hot water is the great equalizer when it comes to household energy consumption. The amount of energy consumed by an average household for hot water will vary by the number of occupants and, generally speaking, not with the architectural features of the house. Percentages of total energy use consumed annually range from 25 percent to as much as 40 percent.

Predicting the percentage of energy used in a home for hot water is imprecise at best. Small tract homes in mild climates with a high number of teenage occupants, will obviously benefit more on a percent utility savings basis than an elderly couple living in a 3,000 square foot custom home in a climate with cold winters and hot summers. The real point here is that sizing a solar water heating system as part of an overall energy strategy for a new home is more of an art than a science.

Typically, cold water entering a conventional water heater is heated from 60- to 120-degrees Fahrenheit, or a 60-degree rise in temperature. The amount of energy used to heat water is expressed in BTUs (British Thermal Units), which was defined many years ago as the energy required to raise one pound of water, one-degree Fahrenheit. One gallon of water weighs 8-1/3 pounds and, therefore, it takes 500 BTUs (8.33 x 60) to heat each gallon of water entering the water heater tank.

Water heaters are required by law to have an energy factor (EF) of no less than 0.58. This represents the amount of hot water you actually get as a percentage of what you pay for. In other words, a gallon of water will consume 862 BTUs of energy to deliver one gallon of hot water at the faucet. Almost half of the heat energy will be lost by the hot exhaust gasses from the burner due to heat lost off of the tank with the pilot light staying on 24 hours a day.

Utility companies charge by the therm. One cubic foot contains 1,031 BTUs of thermal energy. A therm is 100 cubic feet of natural gas containing 103,100 BTUs of energy. This is about the same energy (91,000 BTUs) contained in a gallon of liquid propane (LP). If a household uses 100 gallons of hot water in a day, it has consumed 86,200 BTUs (0.86 therms) of energy.

How much do natural gas water heaters contribute to the global warming issue? The products of combustion of natural gas are water and carbon dioxide (CO_2). According to the source *EIA Natural Gas Issues And Trends* (1998), 17,000 pounds of CO_2 are released into the atmosphere for every billion BTUs of natural gas burned. When all the numbers are put together, an average household using 100 gallons of hot water per day contributes 3,673 pounds of CO_2 to global warming each year.

Replacing a standard tank-type water heater with a "tankless" water heater is a step in the right direction, although it is no substitute for solar water heating. The typical energy factor for a tankless water heater is 0.84. Changing from a tank-type water heater with an EF of 0.58 to a tankless water heater of 0.84 reduces the heat losses by 26 percent. Instead of using 86,200 BTUs to heat 100 gallons of water (50,000/.58), the tankless water heater will use 59,524 BTUs (50,000/.84). This is why it is always recommended to couple a tankless water heater with a solar water heater. Why buy a hybrid car and put lead weights in the trunk?

> "...The concept of solar water heating is to heat the water before it enters the gas-fired water heater, whether it be a tank or tankless water heater."

The Concept

Simply stated, the concept of solar water heating is to heat the water before it enters the gas-fired water heater, whether it be a tank or tankless water heater. Remember it takes 500 BTUs to heat one gallon of water from 60 to 120 degrees Fahrenheit, but if you preheat the water coming into the water heater from 60 to 100 degrees Fahrenheit, you reduce the energy required to heat that gallon of water to only 167 BTUs, a savings of 333 BTUs, or two-thirds of the cost of heating water the old fashioned way. Almost all solar water heating systems will deliver preheated water over 120 degrees Fahrenheit on a fairly consistent basis. An anti-scald valve must be installed on every solar water heating system to cool down the solar preheat as a safety precaution. Most people do not appreciate the fact that

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solar preheat can exceed 180 degrees Fahrenheit. Never install a solar system without an anti-scald valve!

Sizing a solar water heating system is more of an art than a science. A very important consideration is the storage tank capacity relative to the solar collector size. Too much solar collector area on the roof coupled to an undersized tank will cycle from very hot to very cold more often than a system with a properly sized tank-to-collector ratio. Also, temperatures will vary from winter to summer depending on the angle of the roof-mounted solar collector relative to the position of the sun. Many homeowners prefer not to elevate the angle of the solar collector for aesthetic reasons. Optimum performance would be to slope the solar collector at about the same angle as the latitude of the house. This would maximize the perpendicularity with the sun on an annual basis. For example, the latitude of the southern states is about 34 degrees while the latitude of the northern states is about 47 degrees.

Many people make the mistake of installing solar collectors for use in space heating at too shallow of an angle. They will underperform in the winter when you need them to perform and over-perform in the summer when you can't use the heat. The system then will have serious overheating issues. Evacuated tube solar collectors in northern latitudes are often recommended to be installed on a vertical south-facing wall of the house. They perform best in the winter and do not overheat in the summer. Evacuated tubes also work better than other types of solar collectors in the winter because they are less affected by cold air temperatures.

The Economics Of Solar Water Heating

Most water heaters use either natural gas or liquid propane as the source fuel. There are still many electric water heaters being used. Solar preheat for electric water heaters has been a "no brainer" for years, since it costs three times less to heat water as it would using natural gas or propane. The return on investment on solar water preheat for electric water heaters is better than owning gold in recent times. With the increases in energy costs due to the increased competition from growing world markets and the current high and uncertain future of gas prices, the return on investment on all solar water preheat applications is an order of magnitude better than a money market account. And there is a $2,000 tax credit for the purchaser of a new solar system approved by the Solar Rating Certification Corporation. Moreover, it has been surveyed that home buyers will pay more for a house with solar.

The economics of solar water heating depends as much on which system you choose to install in your home as it does the cost of fuel. There are several types and varying quality systems to choose from. Most consumers are understandably reluctant to purchase solar water heating because, unlike other major appliances, such as dishwashers, refrigerators, ranges and the like, solar water heating is far from being in the mainstream. Since the consumer has little to go on when considering a purchase of a solar system, the first question one should ask is, "What is the payback?" It is unfortunate that this is the benchmark that most consumers will use to decide which solar system to purchase, if any. The better question is, "Should I buy a system with a five-year payback that will last 10 years or a system with a seven-year payback that will last 50 years?"

The answer to these questions invokes the principal of life-cycle cost analysis (LCCA) familiar to engineers but missed on most consumers. While many businesses evaluate economic alternatives when investing in more efficient equipment to improve operations that in turn improve profitability, I can't think of even one product the average consumer buys that is based on payback, much less life-cycle cost analysis.

Let's assume that solar water heating is an attractive investment alternative. You decided this because:

1. You like the fact that buying a solar water heater will reduce your carbon footprint by 3,000 pounds of CO_2 for the next 30-plus years.
2. You like the fact that you are helping the United States reduce its dependence on foreign fuel (currently 60 percent is imported), thus helping to balance our foreign trade deficit.
3. You recognize that importing all of this oil causes the United States to have to make foreign policy choices we would rather not have to make, now and even more so in the future.
4. You are convinced that China and India are growing and competing for more and more resources that are finite and dwindling, and that the price of energy will continue to rise.
5. You are thrilled that the Federal Government will give you a $2,000 income tax credit on your taxes when you install a solar water heating system.
6. You can borrow an additional $8,000 on a mortgage without needing to qualify for the additional funds.
7. Your system will increase as the value of your house increases.
8. You are able to show your children and grandchildren that you care what happens to them.

What System To Purchase?

Now, let's figure which system you should buy.

Answer: As a mechanical engineer for 38 years and with 25 years of designing, installing, and servicing many hundreds of other people's and my own solar systems, the longevity and service issues have the most impact on life-cycle costing. When you see a metal "solar storage" tank, glass-lined, stainless steel, or otherwise, just say no. When you buy a system with a tank that will need replacement, you had better add in the cost of several future tank installations. I can only guess what plumbers will charge to replace a tank in 10, 20, or 30 years.

When you see something that looks like the inside of a submarine with several side arm pumps and heat exchangers, with gadgets and valves, expect to be aggravated on a regular basis, and having to pay the service guy to keep it running.

TrendSetter Industries drain-back solar tanks, with internal copper heat exchangers installed, have the best success track record. For three decades they have required little, if any, service and keep going and going and going.

For more information, please visit www.trendsetterindustries.com. UHD

The Author

Norm Ehrlich founded Six Rivers Solar, Inc. in 1979, and currently serves as Senior Engineer for TrendSetter Industries, Inc., manufacturers of solar hot water systems. In the past 25 years, he has designed and installed all aspects of residential and commercial solar thermal systems, wind energy systems, off- and on-grid photovoltaic systems, and sunrooms. He has a strong commitment to alternative energy, ecology, and cost-saving energy efficiency. His extensive career prior to starting Six Rivers Solar includes such positions as business law instructor at Humboldt State University, Mechanical Engineer for Westinghouse, Project Engineer for the U.S. Coast Guard Office of Research and Development, and a trial attorney for the U.S. Consumer Products Safety Commission. He holds a BS in Mechanical Engineering from the Pratt Institute and earned a Juris Doctor Degree in Law from the University of Baltimore. Norm has been a member of the Maryland State Bar, the U.S. Patent Bar, and the California State Bar; he is also a licensed General Contractor and holds several patents for energy-efficient products. TrendSetter is based in Eureka, California. Norm can be reached at 707 498 2466 or by email at norm@sixriverssolar.com.

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Building America's Borrego Springs Project

Rob Hammon, Ph.D.

synopsis

- *California's finite and expensive sources of electricity provided the impetus for this project, since summer cooling is the biggest load factor on the state's utilities.*
- *Analysis of the demonstration homes to date presents an overall energy savings of approximately 65 percent, including heating, cooling, lighting, and other uses.*
- *The use of sustainable, renewable resources in residential new home construction, such as the photovoltaic solar system that generates electricity from sunlight, available in abundant quantity in Borrego Springs, is the way of the future.*

Introduction

There are three certainties in life: death, taxes, and the fact that Borrego Springs, California will be very hot in the summer months. That's why Palo Alto, California-based Clarum Homes, working in partnership with the U.S. Department of Energy's Building America program, ConSol™, and the Davis Energy Group recently constructed four zero-energy test homes in this desert area.

How The Project Came To Be

California's finite and expensive sources of electricity provided the impetus for this project, since summer cooling is the biggest load factor on the state's utilities. Clarum Homes' president John Suppes, an outspoken proponent of energy-efficient building practices, continually searches for new methods he can incorporate into his company's production home communities, and Borrego Springs was the perfect setting for this experimental project. Located 85 miles northeast of San Diego in the Sonoran Desert, Borrego Springs is a hot, dry desert area with average summer temperatures ranging from 100 to 107 degrees. The resort town of 3,000 is surrounded by a 600,000-acre state park and is often listed as the hottest place in the U.S. on certain summer days. The severe climate of Borrego Springs made it an ideal place to study the reduction of cooling loads in residential new homes. Four

ENERGY efficiency

prototype/demonstration homes were built, using four different sets of energy features. The project includes the use of three different types of wall systems on one home design.

The Project Goals

The project goals were specific and measurable. The first goal was to find new ways to build highly energy-efficient, sustainable production housing for the entry-level buyer or move-up market, by California standards.

> "Energy-efficient green building methods are gaining currency in the West, and this project will provide much data and information for builders who want to build smart for many years to come."

A second goal was to achieve up to a 90 percent reduction in cooling costs than would be observed in a contemporaneous home built without the special energy-efficiency features of the Borrego Springs project. Third, Clarum Homes and its partners wanted to build energy-efficient homes with highly sustainable characteristics, while meeting California Zone 4 structural requirements. A fourth goal was to collect data on costs, construction schedules, production feasibility, energy efficiency, product lifecycles, and energy savings to determine cost effectiveness of sustainable technology applications in relation to affordable and entry-level new residential construction. Clarum's overarching goal was to generate data that could assist residential builders of production homes, not just custom builders with unlimited budgets, to provide attractive, appealing homes that are also highly energy efficient and comfortable to live in.

The Project Particulars

The following graph depicts the four demonstration homes, and which specific energy-efficient features were used in each. All four homes used:

- 3.2-kW photovoltaic solar electricity generating systems
- tankless water heaters
- re-circulating hot water systems

- tightly sealed ducts
- radiant roof barriers
- low-E windows
- five-foot shade overhangs at perimeter
- shade screens on all windows and doors
- ENERGY STAR® appliances
- fluorescent lighting
- colored concrete floors
- natural stone countertops
- water-conserving fixtures
- drought-resistant landscaping
- energy-efficiency monitoring equipment

Energy Savings

Preliminary data shows that the Borrego Springs project is well on its way to meeting the goals set forth (see above). Analysis of the demonstration homes to date presents an overall energy savings of approximately 65 percent, including heating, cooling, lighting, and other uses. A number of inspection tests have already been completed on the duct system, windows, and insulation, with more comprehensive building envelope air-leakage tests expected in the next few weeks. The benchmark home data is provided by Building America, and comparisons are done using the same floor plan, the same square footage, and the same climate zone.

Through the use of the 3.2-kW rooftop photovoltaic electricity generators, each home will, on an annual basis, produce almost all of the electricity required for normal home operation. Electricity meters at each home are hooked up to the local utility grid and can actually send electricity back to the grid during the day whenever the photovoltaics are producing more than the home needs. The home then draws the electricity it needs after sundown from the grid. The Borrego Springs homes will be nearly self-sufficient.

Wall System Comparisons

In Demonstration Homes 1 and 2, thermal mass wall systems with standard interior framed walls were used. The project manager noted a longer plan review time from the local jurisdiction for this feature, which can add cost. Other issues with this wall system included difficulty in providing adequate flashing at windows and doors, and the cost and time to ship, handle, and erect the systems. In Demonstration Home 3, the Structural Insulated Panels (SIPs) presented difficulty in installation with seismic requirements for hold-downs and inadequate provisions for electrical wiring and plumbing. It is anticipated that with subsequent use and practice, these concerns will be minimized. In Demonstration Home 4, no issues were noted with the high-efficiency framed walls and engineered lumber.

Building For The Future

Every partner working on the Borrego Springs project is committed to higher energy-efficiency standards in building and undertook this assignment to further that cause. “More builders should be building responsibly,” says Clarum Homes’ Suppes. “We embarked on this project to generate data that will give production builders the methods to build the entry-level and move-up homes California needs, while not overburdening the state’s already taxed energy infrastructure,” he added.

The use of sustainable, renewable resources in residential new home construction, such as the photovoltaic solar system that generates electricity from sunlight, available in abundant quantity in Borrego Springs, is the way of the future. Increasingly, architects and home designers are learning the techniques of climate-responsive and climate-specific architecture, on display at the Borrego Springs project.

Borrego Springs Project Partners

The Building America project combines the knowledge and resources of industry leaders with the U.S. Department of Energy’s technical capabilities. Building America is a private/public partnership that develops energy solutions for new and existing homes. Together, they act as a catalyst

for change in the home-building industry. The partnership works on a cost-shared basis with more than 470 industry partners, which include leading national and regional builders who produce about 50 percent of all new housing, local home building associations, and individual builders. The primary goal is to enable the industry to adopt Systems Engineering approaches to the design and construction of a large portion of all new housing. By 2020, the Building America program is aiming for a 70 percent reduction in energy use through energy efficiency with the remaining 30 percent provided by on-site generation, such as photovoltaics. New Building America research homes already use from 30 to 40 percent less total energy than comparable traditional homes, and in the case of these Clarum test homes, 60 to 70 percent less total energy.

The Building Industry Research Alliance (BIRA) team, a diverse coalition of thirty-one industry partners, is a group within the Building America program dedicated to furthering the cause of the Zero-Energy Homes (ZEH) program. The team uses a Systems Engineering approach to produce homes on a community scale that use 40 to 70 percent less energy, reduce construction time and waste, improve productivity, provide new product opportunities, and implement energy and material-saving technologies.

ConSol, BIRA team lead, and Borrego Springs team lead have been working for builders since 1981 providing a full range of services to improve quality control of energy-related features in new homes and are recognized as the builder’s energy advocate for the building industry at local, state, and national levels, and is committed to assisting the builder to improve profits, cost-effectively

achieve the highest level of quality, and avoid costly litigation. ConSol provides energy code compliance, mechanical engineering, ComfortWise, and many consulting opportunities to the residential builder.

The Davis Energy Group (DEG) has been a leading innovator in cooling and heating technology for residential, commercial, and institutional applications since 1981. Their work encompasses efficient cooling, heating, and building systems, including system analysis, design, controls, simulations, product development, and technology transfer. The NightBreeze ventilation cooling and OASys advanced evaporative cooling systems used at the Borrego Springs homes were developed by DEG.

Conclusion

The Borrego Springs project has already demonstrated that cooling loads and electricity costs can be sharply reduced with the addition of energy-efficient building

Energy-saving feature	Demonstration Home #1	Demonstration Home #2	Demonstration Home #3	Demonstration Home #4
Thermal mass wall	X	X		
Structural Insulated Panel System (SIPS)			X	
2 X 6 framing				X
Engineered lumber				X
Polystyrene insulation (walls & foundation)	X	X	X	X
Freus cooling system	X			
NightBreeze cooling system	X			
OASys cooling system		X	X	
Lennox cooling system				X
Icynene insulation				X
Foam-wrapped building envelope				X
Radiant cooling	X	X	X	
Radiant heating		X	X	
High-efficiency gas furnace	X			X

methods and features, even in a climate area that registers routine temperatures of 100-degrees Fahrenheit or more. Energy-efficient, green building methods are gaining currency in the West, and this project will provide much data and information for builders who want to build smart for many years to come. UHD

Glossary Of Terms

Thermal mass walls: Thermal mass is the ability of a material to absorb heat energy. A lot of heat energy is required to change the temperature of high-density materials like concrete, bricks, and tiles. They are, therefore, said to have high-thermal mass. Lightweight materials, such as timber, have low-thermal mass.

Polystyrene insulation: Polystyrene—a colorless, transparent thermoplastic—is commonly used to make concrete block insulation and a type of loose-fill insulation, which consists of small beads of polystyrene.

Freus cooling system: Freus is an efficient split system condenser, which utilizes a cooled condensing coil, achieving a high-cooling efficiency.

NightBreeze cooling system: NightBreeze is an integrated heating, ventilation cooling, air-conditioning, and fresh air ventilation system that saves energy, improves indoor air quality, and enhances comfort.

OASys cooling system: An evaporative system, where outside air is pulled in by a blower, which is first indirectly cooled, then directly cooled before entering the conditioned space, using about 75 percent of the outside air. The remaining air is humidified and exhausted.

Tankless water heating: A water heater that has no holding tank, but heats water instantaneously as it's needed in a fin-tube heat exchanger. Since storage is unnecessary, there is no standby energy loss associated with the storage of hot water.

Re-circulating hot water: When the hot water faucet is turned on, all the water sitting in the supply line has to move through the pipes before the hot water from the tank reaches the faucet. By adding a return line from the most distant faucet and installing a re-circulating pump, hot water is constantly circulated in the supply line, resulting in appreciable water savings.

Tightly sealed (air) ducts: According to protocols, the use of materials such as galvanized metal and flexible duct, as well as mastic sealants and mesh in the seams between the ducts, conditioned air loss is greatly minimized by tightening the ducts, resulting in huge energy savings.

Low-E windows: Low-emissivity interior and exterior coatings block and reflect much solar heat gain while transmitting most visible light in both the winter and summer, increasing comfort in the home.

Radiant barriers: A radiant barrier is an aluminum foil tent installed in an attic space to deflect radiated heat from the roof. This reflective surface blocks the heat waves from radiating to the ceiling below, so less unwanted heat reaches the living spaces.

Shade screens: A high-quality, optical grade of shading mesh, designed to block up to 90 percent of the sun's heat without blocking the view.

Fluorescent lighting: The light produced by a fluorescent tube is caused by an electric current conducted through mercury and inert gases. Used mainly indoors, it is three to four times as efficient as regular lighting and can save much energy.

Structural Insulated Panel System (SIPS): Panels are made of super-insulating expanded polystyrene (EPS) glued to an inner and outer skin. The result is a single stressed-skin panel with strength, durability, and thermal efficiency. The panels join together to build walls, floors, and roofs that are lightweight yet can withstand high wind loads and the twisting and flexing that slowly deteriorate conventional buildings.

Lennox: Manufacturer producing high-end heating and cooling systems that save energy and money.

Icynene: Manufacturers of the Insulation System, an environmentally friendly, dual-performing insulation and air barrier.

Engineered lumber: High-grade wood fiber, environmentally safe adhesives, and heat and pressure create virtually defect-free engineered lumber capable of supporting heavy loads over long spans. Engineered lumber uses less timber and can be made from young, rapid growth trees.

The Author

Rob Hammon, Ph.D., is the Principal at Stockton, California-based ConSol. Hammon's consulting team was able to play a key role in the Borrego Springs project. His work as co-chair of the California Energy Commission's (CEC) New Solar Homes Partnership Advisory Committee, whose mandate is to advise the CEC how to create the most effective program to encourage solar technology in new home construction, is closely aligned with the Borrego Springs project. Hammon's overall goal is to couple energy-efficiency with solar, and the data gained from the Borrego Springs project will substantially help in furthering that objective.

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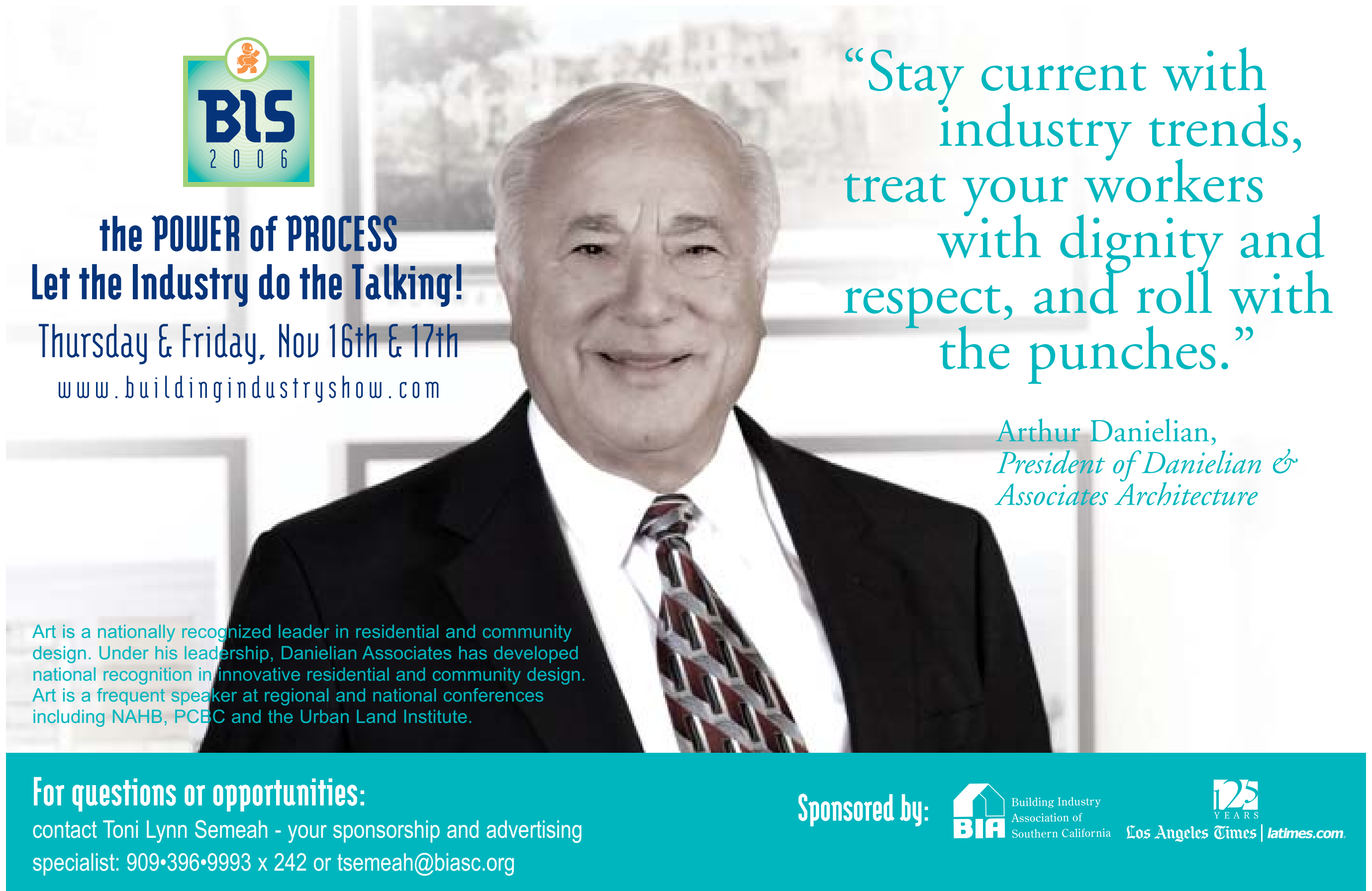

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So You Want A LEED® Home...

what's it going to take to get one built?

Jay Hall, Ph.D. &
Ann V. Edminster, M. Arch.

synopsis

- *The basic mind-set of the project team must be that green home building is an on-going learning process.*
- *After deciding to pursue a LEED® Home rating, a builder will work with the LEED for Homes Provider to decide on the desired LEED Home performance level (i.e., Certified, Silver, Gold, or Platinum) and identify which credits to pursue.*
- *Execution of the construction process has a very large impact on the prospective success of the bid for a LEED Home rating.*
- *The LEED for Homes Provider serves as a third-party verifier for determining if a home qualifies for certification under the LEED for Homes Rating System.*

Part III: Integrating LEED® Into The Construction Process

Overview

Note: The LEED for Homes™ pilot began in August 2005 and will continue throughout 2006 and until the rating system is approved by the U.S. Green Building Council (USGBC) membership in early 2007.

As highlighted in the two previous articles in this series (Issue 03, May/June 2006 and Issue 04, July/August 2006), LEED for Homes is much more than a process for assigning a "score" to a completed building that indicates how green the building's components are. From the early feedback received from the pilot LEED Homes, a successful LEED project requires early engagement of all members of the design and construction team, as well as ownership of the "green" project goals by each member of the team.

The Basic Building Blocks Of A LEED Home

This third article in the series is focused on the construction phase of the project. The oversimplified view of the construction process is that it is simply assembling the pieces of the home that were designed earlier in the project. However, the reality is that the many construction trades each contribute to overlapping aspects of the overall home. Because of these overlaps, it is critical that the trades all fully understand the goals of the project and work together to meet these goals. The critical role of integrating the trades falls on the construction superintendent. His contribution to the overall success of the project includes three critical tasks:

- Creating initial awareness of unique aspects of the project with each trade
- Providing detailed scopes of work
- Reviewing and signing off on each completed task

The basic mind-set of the project team must be that green home building is an on-going learning process. There are many emerging green home building products and techniques. The project team needs to learn about these green home building products and practices and understand whether they best contribute to the project goals. As more green home building practices are incorporated into a home, the better performing the homes will be from perspectives of health, safety, comfort, durability, energy efficiency, and overall environmental stewardship. Owners of green homes are proud to know that their homes are built substantially better than conventional homes.

Timing And LEED Credits

As discussed in the previous articles in this series, after deciding to pursue a LEED Home rating, a builder will work with the LEED for Homes Provider to decide on the desired LEED Home performance level (i.e., Certified, Silver, Gold, or Platinum) and identify which credits to pursue. Shortly thereafter, the builder will need to collaborate with his/her staff, subcontractors, and consultants to develop a plan for ensuring that the targeted LEED credits are successfully earned. It will be helpful in that planning process to identify credits whose achievement relies on early design and/or construction decisions and corresponding actions or tasks on the part of the builder's team members, and credit decisions that can be deferred until sometime farther down the road without jeopardizing successful implementation. This evaluation step is particularly important in relation to both "yes" and "maybe" credits that require early or even mid-stream decisions by the builder.

Credits fall into four groups with respect to the significance and flexibility of when these "go/no-go" decisions need to be made:

1) Credits that are determined by the site selection;
2) Credits that require early decisions for their successful implementation;
3) Credits that can be decided on midstream during design; and
4) Credit decisions that can be made well into the construction process.

> "It is critical that the trades all fully understand the goals of the project and work together to meet these goals."

Credits that fall into each of these groups are enumerated below. Note that in each case the credits are listed not in decision, design, or construction sequence but in numeric order within each LEED for Homes category (the categories are ordered alphabetically). Innovation and Design Process (ID) credits vary based on the nature of the credit and should, therefore, be considered early after the decision to pursue a LEED Home rating.

Credits Determined By Site Selection

The few credits in this group are all in the Locations & Linkages category of LEED for Homes.

LL2 Avoid Environmentally Sensitive Sites and Farmland
LL3 Proximity to Existing Infrastructure
LL4 Walkable Access to Community Resources/Public Transportation/Green Space

Credits Requiring Early Decisions

The following credits require an early commitment on the part of the builder and/or owner to ensure their successful implementation in the project. These are decisions that have the capacity to affect the building configuration and/or that, for their correct execution during construction, must be reflected in the construction documents and/or scopes of work for the construction trades. They may be decisions with systems implications—that is, decisions on these credits may affect other aspects of the home's performance and thus should be considered in light of the related design and construction issues.

LL5 Compact Development
EA1 Meets or Exceeds ENERGY STAR® for Homes
EA2 Insulation HERS (Home Energy Rating System) Grade I or Better and Third-Party Inspected
EA3 Envelope Air Leakage ≤0.35 ACH and Third-Party Tested
EA5 Duct Leakage to Outside ≤5.0 CFM25/100SF and Third-Party Tested
EA7.1 Improved Hot Water Distribution System
IEQ1 ENERGY STAR for Homes with Indoor Air Package
IEQ10.1 No Air Handling Equipment or Return Ducts in Garage

IEQ8.1 Seal Off Ducts During Construction
IEQ9 Install Radon Mitigation System
MR1 Home Size
MR4 Durability Planning and/or Third-Party Verification
MR6 Construction Waste Minimization
SS1.1 Minimize Disturbed Area of Site (If Site >1/3 Acre)
SS1.2 Erosion Controls During Construction

Credits That Can Be Decided Midstream

"Go/no-go" decisions on the credits listed below can be deferred until some time during the design development process or even, in some cases, during construction. In most cases, the decisions will need to be reflected in the construction documents and/or purchasing documents in order to ensure achievement of the credits.

EA4 Windows Meet/Exceed ENERGY STAR
EA6 Meets/Exceeds ENERGY STAR for HVAC w/Manual J+ Refrigerant Charge
EA10 Renewable Electricity
EA11 Puron or No Air Conditioning
IEQ10.2 Tight Seal Between Garage and Home
IEQ10.3 Exhaust Fan in Garage OR No Garage in Contact with Home
IEQ3 Analyze Moisture Loads/Install Central System
IEQ4.1 Supply Ventilation Meets ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) Standard 62.2
IEQ4.2 Dedicated Outdoor Air System
IEQ5.1 Exhaust Ventilation Meets ASHRAE Standard 62.2
IEQ5.2 Bathroom Exhaust Fan Timers/Automatic Controls
IEQ6.1 Space Conditioning Designed to Meet ACCA (Air Conditioning Contractors of America) Manual D
IEQ7 Supply Air Filtering
IEQ8.2 Permanent Walk-off Mats or Central Vacuum
MR2 Material-efficient Framing
MR5 Environmentally Preferable Products
SS4.3 Permanent Erosion Controls
SS5 Insect and Pest Control Alternatives
WE1.1 Rainwater Harvesting

Credit Decisions That Can Be Made During Construction

Decisions regarding the credits listed below can be made relatively late, often even during construction. Achievement of these credits will rely on close control of purchasing and construction completion-related activities; many of these decisions, therefore, need to be reflected in material and equipment specifications and other relevant documentation.

EA7.2 Improved Hot Water Equipment
EA8.1 Energy-Efficient Fixtures & Controls
EA8.2 ENERGY STAR Advanced Lighting Package
EA9 Resource-efficient Appliances
HA1 Owner's/Occupant's Manual and Home Walk-through(s)
IEQ2.1 Space Heating + DHW (Department of Housing and Works) Equipment w/Closed/Power-Exhaust; CO Monitors
IEQ2.2 Fireplaces w/Outside Air Supply, Closed Combustion
IEQ4.3 Third-Party Testing of Outdoor Flow Rate into Home
IEQ5.3 Third-Party Testing of Exhaust Air Flow Rate out of Home
IEQ6.2 Third-Party Testing of Supply Air Flow into Each Room
IEQ8.3 VOC Testing
MR3 Local Materials
SS2.1 Basic Landscaping Design
SS2.2 Mulch Around Plants
SS2.3 Limit Turf
SS2.4 Minimize Landscape Water Demand
SS3 Locate Trees to Shade Hardscapes, or High-Albedo Paving
SS4.1 Install Permeable Material for ≥65 percent of Lot (If Lot ≥1/4 acre)
SS4.2 Use Permeable Paving Materials
WE1.2 Grey Water Reuse System
WE2 Irrigation System
WE3 High/Very High Efficiency Fixtures (Toilets, Showers, Faucets)

The Construction Process

As the preceding section suggests, execution of the construction process has a very large impact on the prospective success of the bid for a LEED Home rating. Site selection governs a few credits, and design decides a good number more; but the construction has the potential to make or break the project's LEED rating—it can cause a project to fail to achieve any LEED Home rating at all, or it can cause a project to score lower than it otherwise might have. And conversely, a well-executed construction process will greatly smooth the way toward the desired LEED and other project goals.

The degree to which the construction process supports the project's LEED goals can, in many cases, be traced back to activities at the outset of construction that set the stage for subsequent work. We recommend that the builder or general contractor undertake several specific tasks to enhance the project's opportunities for success. Each of these is discussed in the following paragraphs.

Project Kick-Off Meeting

As described in the earlier articles, representatives of the whole of the project team should participate in the first project kick-off meeting (prior to the first phase of design). The owner and/or builder, construction superintendent, project architect, and all key consultants should attend this meeting. The purpose of this meeting is to develop the project goals and specific design strategies with substantive input from these key members of the project team. In this meeting, the project team should identify the LEED credits to be targeted (with particular attention to the timing issues highlighted earlier in this article), assign responsibility to project team members for follow-through on specific credits, specify sign-off parties for Accountability Forms, identify potentially problematic credits (with emphasis on mandatory measures), and assign responsibilities to team members for needed research and issues to be addressed in construction documents, contracts, etc., in order to ensure the project's success in achieving the desired LEED Home rating.

Construction Kick-Off Meeting

After the design has been completed and the construction process is about to begin, a construction kick-off meeting should be held. The owner and/or builder, construction superintendent, project architect, key consultants, Provider, and all of the trade supervisors should attend this meeting. The purpose of this meeting is to ensure that all of the subcontractors (or trades) clearly understand the project goals and their individual roles in contributing to the successful achievement of those goals. The meeting also should specifically identify the process that will be used to verify the adequate completion of each task by each trade. Ideally, a detailed scope of work will be provided to each trade (see more information on this below).

Three levels of approval should be required for all tasks, including:

- Sign-off by trade supervisor;
- Sign-off by project supervisor/construction superintendent; and
- Sign-off by LEED for Homes Provider (i.e., whenever LEED for Homes inspections and/or performance tests are required).

A typical agenda for this meeting might include:

- Review of project goals
- Critical tasks
- Expected challenges
- LEED responsibilities by trade
- Timing
- Oversight, inspections, and performance tests
- Remediation steps, if performance goals are not met
- Suggestions
- Discussion

A critical subject of discussion should be specific methods of addressing tasks that require coordination between trades. For example, electricians and plumbers frequently have to drill a large number of holes in the framing to run wire and piping throughout the home. The responsibility for properly sealing these holes (especially holes that penetrate the thermal enclosure) should be clearly assigned either to each trade or to an air-sealing contractor that will come in and seal behind each of them.

Note that these two meetings, as described, represent an ideal scenario, in which the owner or builder decides to pursue a LEED Home rating before the start of design, and can begin work with his/her whole team on that premise. However, as is often the case, if that decision is made later, these two meetings may be combined or may occur in a compressed time frame. The meeting purposes and agendas should be adapted accordingly.

Scopes of work for construction trades—along with construction drawings and specifications—should be provided with a detailed scope of work. The purpose of this scope is to clearly define all tasks that the trade is responsible for completing and how "task completion" is defined (e.g., who decides, and the specific metrics used for determining successful task completion, or achievement of project goals). At a minimum, a scope of work should include the following:

- Detailed list of materials
- Schematics of special requirements
- Inspections that must be satisfied
- Performance tests that must be satisfied
- Sign-offs that are required to verify that work has been completed

Training

Depending on the builder's and trades' familiarity with the type and quality of work required for achievement of the targeted LEED credits, some on-site training may be needed. Clearly, the sooner these needs are identified, the better. If the builder or general contractor has another home under construction—ahead of the LEED project—that home provides an ideal training opportunity. We have found during the LEED for Homes pilot that some builders who are initially unfamiliar with the ENERGY STAR Homes program requirements nevertheless choose to pursue that route (EA1). Their success at achieving the desired energy score (HERS rating) relies on an adequate level of "tight" construction—both in the building enclosure and in the duct system. Since it is difficult for the builder or trades to know in advance whether their accustomed level of workmanship will achieve the requisite level of airtightness, advance training and testing is highly desirable. If this training and testing cannot be performed in another home, it must be done in the home(s) pursuing the LEED rating. While this represents some challenges, it is not insurmountable; advanced planning

Exhibit 1
List of Performance Tests for Verification of a LEED Home

List Of Special Measurements		Done By	Performance Level	
Category	Credit		Mandatory	Optional
EA	1 ENERGY STAR Home	Rater	X	
	3 Envelope Air Leakage	Rater	X	
	5 Duct Leakage	Rater	X	
	6 Refrigerant Charge	HVAC	X	
IEQ	4.3. Outdoor Air Flow Test	Rater		X
	5.3 Exhaust Air Flow Test	Rater		X
	6.2 Supply Air Flow Test	Rater		X
	8.3 Contaminant Testing	Third Party		X

and coordination is crucial, however. The required quality of insulation installation is another such issue. Other construction processes or methods that may entail training include radon-resistant construction, erosion control, waste management, certain durability measures, advanced framing, and alternative pest control techniques.

Verification

The LEED for Homes Provider serves as a third-party verifier for determining if a home qualifies for certification under the LEED for Homes Rating System. Only the Provider can confer a LEED Home certification.

The three-step LEED for Homes certification process is outlined below. Note that the preliminary rating (design review) is only needed once per model of home built, whereas the final rating must be performed for every home built (of every model). (An exception is the LEED for Homes Sampling Protocol that allows large production builders to use a one-in-seven testing approach.)

Step 1: Preliminary Rating

1.1 Detailed plan review of a builder's home design

1.2 Performance testing of a typical example of builder's home design (optional)

1.3 Preliminary determination of LEED for Homes score/rating

Step 2: Final Rating

2.1 Pre-drywall inspection

2.2 Final inspection and performance testing (see Exhibit 1)

2.3 Completion of project documentation file (including completed LEED for Homes checklist, performance test reports, and completed Accountability Forms, and other project-specific requirements based on credits earned)

2.4 Final LEED for Homes scoring/rating

Step 3: Certification

3.1 Review of project documentation file (including data listed in Exhibit 2)

3.2 Approval of LEED Home rating and presentation of LEED Home label and rating certificate to builder or owner

3.3 Notifying USGBC of rating

Note: These steps parallel those required to verify an ENERGY STAR-labeled Home.

Final Delivery Of The LEED Home

Ultimately, the "greenness" of the operation of the home is out of the builders' and designers' hands. However, two mandatory aspects of the delivery of a LEED Home, both of which occur post-construction, are designed to educate the homeowners or occupants about the features and operating and maintenance requirements of the new LEED Home.

The builder is required to walk through the LEED Home with its new owners or occupants, identifying and demonstrating all of the "green" features, equipment, controls, and other key performance aspects of the home. (If the owners or occupants are not known at the time of certification, the builder must show evidence of his/her intent to conduct the walk-through, such as a walk-through outline or similar materials.)

The builder also must provide a manual containing all information pertinent to the ongoing use of the home in a fashion that will support its continued environmental performance. The manual must contain, at a minimum, the following items:

- The LEED for Homes rating certificate and completed checklist
- Manufacturers' manuals for all installed equipment, fixtures, and appliances
- Information on efficient use of water, energy, and natural resources
- Guidance on occupant activities and choices, including:
- Water-efficient landscaping
- Impacts of chemical fertilizers, insecticides, and pesticides
- Irrigation
- Lighting selection
- Appliance selection
- Information on green power options

These measures—the walk-through and manual—are intended to ensure to the greatest extent possible that the environmental performance designed into the home, and hoped for in its ongoing use, will be fulfilled.

Exhibit 2
Items Required in Provider's Project Documentation File

1. Set of construction drawings, specifications, and scopes of work
2. Completed checklist, including the following information:
   - Builder, general contractor, and/or owner name(s)
   - Home address
   - Provider's name and signature
   - Rater's name and signature
3. Copy of ENERGY STAR for Homes certificate (if applicable)
4. Reports for completed performance tests (see list in Exhibit 1)
5. Completed Accountability Forms—one for each organization or individual whose sign-off is required for one or more completed credits (credits requiring Accountability Forms are marked with a "✍" symbol on the checklist); forms include the following additional data:
   - Subdivision
   - Date of final inspection
   - LEED score and rating achieved
   - HERS score achieved
   - Energy rating approach used (BOP or HERS score)
   - Sampling protocol used? (Y/N)

A Note On Quality Management

The LEED for Homes initiative offers two primary benefits to a homeowner:

- A home that performs at a substantially higher level than a typical new home (i.e., a home that is built to conform to building codes); and
- A third-party verification of that improved level of performance (i.e., proof that the home is better).

An oversimplified view may suggest that the program is about policing builders by delivering an inspection after the home is built. In reality, the successful construction of a LEED Home requires the commitment of a large team of professionals to learn to effectively integrate new knowledge into every step of the home's design and construction and, more importantly, to abide by the following principles:

- Personal dedication to the project goals;
- Willingness to learn (to make mistakes, and get better with experience);
- Willingness to work as part of a team; and
- Commitment to sharing the lessons learned—what worked and what did not.

Many new homes under-perform, not because of a poor design, but because the project team does not work together effectively. Rarely are construction problems communicated back to the design team. Tremendous progress can be made in improving home performance if project team members share information with one another, if they can embrace change, if they can accept valuable guidance from project supervisors, and, at the close of a project, provide feedback to the design team.

Of course, third-party verification is valuable and embraced by LEED for Homes. But the delivery of high-performance homes requires more than third-party policing. Within LEED for Homes, we are encouraging project teams to learn to work together more effectively, to own in-house quality management processes. Fundamentally, continuous learning is the real key to success. Don't be afraid to try something new and better—and don't be afraid to share the outcomes! UHD

The Authors

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Energy-Saving PowerHouse

Gary Reber

synopsis

- *Introducing an energy-saving demonstration home to help ease the impact of rising energy costs.*
- *Energy-saving improvements abound, pairing a combination of upgraded, but readily available features and techniques with solar thermal and solar technologies.*
- *Using a systems approach, enhancements were made throughout the entire home—building envelope, space conditioning systems, water heating, lighting, and appliances.*
- *A successful model of how the practical application of these readily available energy-producing and conserving technologies can benefit both builders and buyers, while helping to preserve the Earth's natural resources.*

Energy-Saving PowerHouse Opens As One Of The Mid-Atlantic's First Ultra-Efficient Demonstration Homes

As homeowners in Maryland, Washington DC, and Virginia brace for significant energy rate hikes this summer, the U.S. Department of Energy (DOE) Building America program has partnered with the Maryland Energy Administration (MEA), the NAHB Research Center, and local builder—Bob Ward Companies—to introduce an energy-saving demonstration home to help ease the impact of rising energy costs. The PowerHouse, as the home is called, is located in the Baltimore suburb of Bel Air, Maryland and officially opened in June with an open house for building professionals and the general public.

The PowerHouse demonstration home is based on the Greenland model, one of eight home designs offered by Bob Ward Companies. As one of the largest production builders and first ENERGY STAR® builders in the Baltimore metropolitan area, the company places considerable emphasis on improving energy efficiency. Their homes are already distinguished with the EPA's ENERGY STAR label indicating at least 15 percent more energy efficiency than required by code. The company's ongoing commitment to an energy-conscious building philosophy made it a natural choice to build the unique home, which exceeds even the impressive ENERGY STAR efficiency standards.

Linda Veach, President of Bob Ward Companies, remarked, "Our current efforts as an ENERGY STAR builder made the PowerHouse project a natural progression for us. We were pleased to partner in a program that supports our philosophy of providing home buyers with higher performing homes that not only save them money, but also enhance their overall living experience."

Aptly named, the PowerHouse features products, systems, and design techniques that facilitate dramatic improvements in energy performance and lower utility bills for homeowners. Construction of the 2,566-square-foot demonstration model was completed in June. The exterior of the two-story house has a stone facade and two-car garage and looks pretty much like any other single-family production home in the local area. But inside, the energy-saving improvements abound, pairing a combination of upgraded, but readily available features and techniques with solar thermal and solar technologies.

> "...the PowerHouse features products, systems, and design techniques that facilitate dramatic improvements in energy performance and lower utility bills for homeowners."

Using a systems approach, enhancements were made throughout the entire home—building envelope, space conditioning systems, water heating, lighting, and appliances. Some of the home's less visible features help to provide greater occupant comfort, better indoor air quality, enhanced durability, and lower maintenance.

Starting on the outside, solar collectors hug two sides of the roof. One set of panels preheats the home's hot water before the temperature is boosted by a small tankless heater located in the basement. The other set of panels comprise the photovoltaic (PV) system, which generates electricity that can be used in the home or fed back to the utility when excess power is produced, causing the meter to run backward.

Inside, the upgrades are primarily behind the walls but no less significant. The basement is fully insulated and built using the Superior Walls™ prefabricated foundation

system. The precast concrete foundation has a two-inch layer of polystyrene insulation and offers the benefits of structural integrity, good thermal performance, and moisture protection. A half-inch layer of rigid polyurethane insulation supplements the blown-in batt wall cavity insulation. There's extra insulation in the attic as well, plus low-e windows that significantly reduce heat losses and heat transmission to and from the outside. A tankless water heater and PEX manifold plumbing system round out the list of innovations.

The PowerHouse also features a detailed air-sealing package, critical to ensuring occupant comfort. Sealing penetrations between floors and to the exterior of the home reduces leakage to the outdoors and prevents drafts and/or uneven temperatures. Other innovative building techniques of the home include Optimum Value Engineering (OVE) framing, which increases the overall R-value of the entire building envelope. Cost savings can also be achieved with this technique because it reduces waste by eliminating unnecessary framing members.

As a production model, the PowerHouse has been hailed as the first of its kind in the Baltimore-Washington area, and while not rated as a zero-energy home, the PowerHouse is expected to use less than half the energy of a standard, code-compliant home of similar size. The NAHB Research Center, which played an integral part in developing the high-performance energy

efficiency features of the PowerHouse, estimates the upgrades should lower utility bills by more than $160 a month, without calculating the anticipated savings achieved with the PV system.

In recent years, steadily rising utility costs have taken hold across the country, generating a broader interest in energy-saving homes, namely in states like California and New Jersey. The electricity rate increase expected in Maryland is just one example of the latest jump; and with heating oil and natural gas prices already soaring, more Marylanders are starting to look for alternatives to manage their utility bills. Local governments are responding by offering more grants, low-interest loans, and tax credits to install or retrofit solar collectors and other energy-saving devices or systems. On the federal level, DOE's Building America program is working to help develop energy solutions for new and existing homes and is encouraging home builders to incorporate these features as part of their standard construction package.

"A research result that sits on the shelf isn't going to save anyone any energy," advised Ed Pollock, team leader for residential research at the U.S. Department of Energy.

"The PowerHouse," Pollock said, "is one of the most energy-efficient homes built under the Building America program. Not counting the photovoltaic system, the utility savings of the demonstration house is equal to or greater than the additional costs incurred for the upgrades when amortized on a monthly basis and financed into the mortgage."

Now up and running, the PowerHouse will provide a blueprint for other area builders who are considering incorporating energy-saving upgrades, but have found it difficult to balance the advanced technologies with reasonable first costs. The availability of tax credit incentives for energy-efficient homes also helps to offset costs, and will hopefully encourage more builders to implement these market-ready technologies to demonstrate that energy efficiency is compatible with today's suburban living.

Michael Luzier, President of the NAHB Research Center, said, "The PowerHouse provides the mid-Atlantic region a successful model of how the practical application of these readily available energy-producing and conserving technologies can benefit both builders and buyers, while helping to preserve the Earth's natural resources."

While remaining open throughout 2006 for walk-through tours, the home's upgraded design is not currently available to home buyers. Bob Ward Companies does intend to incorporate some of the energy-saving techniques of the PowerHouse into its standard home designs—enough to potentially lower utility costs 5 to 10 percent. The PowerHouse will serve as an educational center for local builders and the area's growing number of energy-conscious home buyers who want to learn more about the systems and features of the house while the systems and energy usage are closely monitored by Research Center technical staff. A sales price has not been set for the home. However, once occupied by a family, the Research Center will continue to monitor and report on the home's "real world" performance.

For more information on the PowerHouse and its features, please visit www.ToolBase.org. UHD

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synopsis

- *What needs to be done to make the usability, adaptability, and user-friendliness of a product/service adapted to the maturing population?*
- *There is a need for a new design paradigm that will make products for mature people user-friendly and thus ensure the consumer's satisfaction and loyalty.*
- *When developing products and services for the mature population, it is important to design them in such a way that their needs are met in a transparent and friendly way, enabling them to positively interact with the product/service.*

"60 Is The New 30" Attitude

From this century on there will always be more mature people (ages 55+) than younger people. This demographic change that drives the world from Baby Boom to Senior Boom is one of the most important trends of our times. It creates a new business frontier—accommodating the lifestyle and needs of this distinct and emerging market.

A lot has already been written about the "baby boomers" and how they influenced industries in every aspect of their lives, but not enough attention has been given to fully understand their needs. The awareness in today's mature market is still mostly on the HOW—how to market, how to communicate. The focus should be on a more significant and fundamental element—the WHAT—what needs to be done to make the usability, adaptability, and user-friendliness of a product/service adapted to the maturing population?

There is still a huge gap that needs to be bridged—a need for a new design paradigm that will make products for mature people user-friendly and thus ensure the consumer's satisfaction and loyalty. This gap must bridge the progressing age-related decline in sensory, cognitive, and motor skills.

Additionally, there is also an age-related digital divide that serves as a very significant obstacle in including baby boomers in the new society dominated by digital technology. It excludes a large percentage of the mature population from the digital literacy that is in the heart of new social, informational, entertainment, medical, and even political worlds.

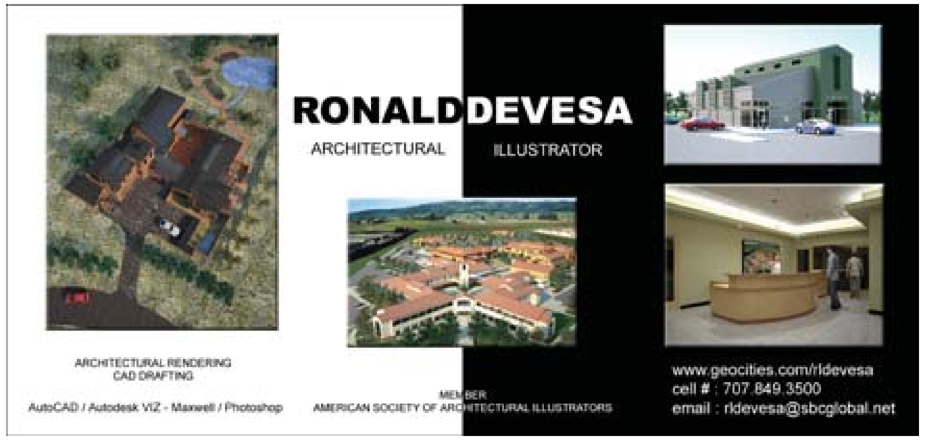
Older people are often challenged by technology and tend to give up on products/services that make them feel uncomfortable. Their desire for a positive user experience is shadowed by the fear of not being able to properly apply the necessary skills or not being able to interact with the application in a timely manner. They would rather give up on the potential, in order not to feel inferior.

Therefore, when developing products and services for the mature population, it is important to design them in such a way that their needs are met in a transparent and friendly way, enabling them to positively interact with the product/service. It is crucial to understand the different state of mind of an older consumer. A younger person that does not have a satisfactory experience in interacting with a product/service will blame it on the design and usability, and will choose an alternative brand. On the other hand, an older consumer will interpret the frustrating experience as a personal failure and will avoid using this product/service out of a personal sense of incapability.

Therefore, senior-user design must be integrated purposely into the R&D and design process and claim that "what is very good for older adults—is excellent for those younger." Lack of adaptation to the needs, preferences, and accommodation to usability capabilities can be the make or break of a mature user's choice to interact with a product/service.

The new baby boomers embrace the "60 is the new 30" attitude—they redefine age, quality of life, and the "joie de vivre" (joy of life). They want to maintain an active lifestyle, take a proactive wellness and health approach to managing their progressing age—related decline in sensory, cognitive, and motor skills for a new quality of life—an ageless lifestyle that will keep them as an integral part of society. As they grow older, they strive to maintain, for as long as possible, an independent lifestyle in their familiar surroundings.

They are experienced, opinionated, and assertive about their needs—affluent, savvy consumers who want to spend on themselves and are willing to pay a lot more for products/services that are suitable and adapted to their lifestyle and yet tailored from an age-friendly design perspective that will enable them to remain part of an ageless lifestyle.



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Senior Health Management Through Home-Activated Medical Devices

Independent home activation of medical devices involves vital aspects of people's quality of life, and it is more so as larger aspects of proactive health monitoring as well as sickness management moves from clinics and doctors into the hands of the patients themselves.

> "A large part [of proactive health monitoring] is done at home through home-activated medical devices, with seniors representing the main users of these devices."

A large part is done at home through home-activated medical devices, with seniors representing the main users of these devices. Such includes basic time-sensitive and time-reminder pill dispensers, blood-pressure and blood-sugar testing devices, and more sophisticated, personal monitoring and administration devices. As advancements in telemedicine will make the potential uses of such devices only grow in scope, it is all the more crucial to facilitate the activation by adapting it as much as possible to the target group.

Home-based medical devices activate complex skills, especially with elder patients. The cognitive-, technical-, and knowledge-based tasks delegated to home-users were previously executed by nurses and doctors. Now they are on their own and their health monitoring depends on their capacity to operate the devices reliably. It is very important to simplify these devices and minimize the contingencies that influence operating technological devices by lay people in the home environment, so that the patient can actually activate a device.

Medical devices activated at home can be generic appliances or

ones that are independently and variably programmable by the patients themselves. Yet ordinary users do not have the prior knowledge and skill—they do not have the appropriate education and experience of healthcare professionals and they are not trained. Still, their health monitoring depends on their independent capacity to operate the devices reliably. It is important to simplify the devices and minimize the contingencies that influence operating technological devices by lay people in a home environment, so that the patient can simply and intuitively activate a "black box."

Safe and effective usage of such devices at home is jeopardized many times due to user errors, lack of maintenance awareness, and inadequacy in operation. Additionally, people independently monitoring bodily functions at home have a high emotional involvement in the process. It can become a very hindering factor in the patient's functionality, especially in stressful situations. Also, monitoring and storing data is done by the patient or professionals (doctors, nurses, archivists, pharmacists) locally or remotely. So, access to data entry and updating can be done through multiple levels of interactions. Although people want to feel independent and possess authority over their data monitoring and health managing process, they are not always skilled to do so.

Important factors that have to be taken into account are that users may have additional issues that complicate the activation, monitoring, and maintenance orders:

- Elderly people may have age-related impairments or deterioration in functional skills. For example, cognitive problems that stem from the need to understand how the device works and physical problems, such as eye-hand coordination, in the manipulation of the device might present a problem.
- It is important to stress that objective age categories are not applicable here because physical age, mental age, and cognitive age dependent on health- and emotionally-related factors are very relative.
- As memory declines with age, it becomes an increasing problem to plan, remember, and execute a sequence of instructions.
- The decline in visual perception prolongs the time needed by elderly people to clearly see the objects on the display device.
- Elderly people suffer from loss of precision in movement coordination.
- Patients may take medicines that can affect their functional skills or memory.
- People with a language barrier may have more difficulty understanding and following instructions.
- Information processing, coupled with the technological and digital gap of many older users of self-activated medical devices, creates an emotional, perceptual, and cognitive barrier. It makes older users very sensitive and error-prone to task complexity. This is even more significant as devices are developed today for the global market, so in addition to age-related factors, they must be developed bearing in mind universal multi-cultural usability aspects so that home users are able to overcome age and cultural barriers and simplify set-up, activation, and monitoring of home devices.

Senior Touch—A 3rd Age Expert House

Senior touch is a 3rd age expert house, built with a new concept—focus on bringing older age-related needs and factors as primary considerations into the world of products, services, environment, and multimedia, and enabling a positive total user experience. As such, we represent the voice of the mature consumer. We focus on the product usability and the extent to which the product can be used by older users to achieve specific goals with effectiveness, efficiency, and satisfaction. In other words, we focus on developing and adapting products, services, and interfaces that will be suitable, user-friendly, and adaptable to the needs, lifestyle, motoric, cognitive, and sensory changes in people ages 55 and up that enable the positive user experience and enable him or her to perform and bridge age-related contingencies.

In several projects that included expert analysis of medical devices for self-activation, we easily discovered that result bias was due to ergonomic or age-related contingencies that had nothing to do with the medical condition per se. In some cases, the solution lies in creating a new version of existing products and even manuals so that they are more friendly and accurate for the mature user.

Therefore, our multidisciplinary team of experts encompasses a wide range of fields: design, technology, usability, gerontology, medicine, ergonomics, engineering, psychology, marketing, and research. For each project, we assemble an ad-hoc team to ensure that all relevant age-related aspects will be taken into account, thus accommodating the special needs of the mature population.

We assist product and/or service providers to adapt their products/services to the mature market and enable the total user experience, encompassing the product/service, the user, and the environment. We are involved in designing, versioning, R&D, and marketing. We offer full out-sourced services or work as a 3rd age expert house in consultation and expert analysis with existing R&D and design functions within the organization.

Senior Touch provides the following services for the 3rd age market:

- Design, research, versioning, and out-sourced development of 3rd age products.
- Expert analysis and 3rd age-related Strategic Consulting services.
- Usability tests, user Interfaces, and man-machine interaction.
- 3rd age-related research.

As we have a strategic focus on bridging the 3rd age-related digital divide, especially in areas of IT (information technology), digital information and communication platforms, devices, products and services, medical devices, self-diagnostics, and telemedicine, we join hands with high-tech companies, appliance manufacturers, and service providers to adapt interfaces, appliances, applications, and services to the modified skills of more elderly users; enable accessibility and man-machine interaction based on age-related ergonomic, sensory, and cognitive factors; adapt user interfaces to age-related contingencies; and offer new services that will enable independent living in the natural surrounding.

For more information, visit www.senior-touch.com. UHD

The Author

Ayala Rahav is a principal in Senior Touch, a company based in Israel, which brings older age-related needs and factors as primary considerations into the world of products, services, content, and mature life-style management. She is an expert in end-user centricity, high-tech, media, business development, and generational and segmented marketing. She can be reached at ayala@senior-touch.com.

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Z-Wave 101

The New Standard For Home Controls

Yan Rodriguez

synopsis

- *Industry giants such as Cooper, Intermatic®, Leviton, Monster® Cable, and Wayne-Dalton® understood that a standard was needed in order to make the long-promised "smart home" a reality.*
- *Formed in January 2005, the Z-Wave Alliance is a consortium of more than 125 leading consumer companies, in areas such as lighting, AV remote control, HVAC, access control, security, pool and spa, home networking, and other consumer industries,dedicated to solidifying Z-Wave as the standard for wireless home control products.*
- *Z-Wave-enabled home controls are ideally suited to provide energy-efficient solutions tailored to the needs of any consumer.*

Introduction

Imagine pulling into your driveway late at night—house sits idle, lights out everywhere, and no knowledge of what lays within. But now something remarkable happens—pressing a button on the in-car remote illuminates the home exterior. Another press of the button opens the garage door, turns on pathway lighting from the garage to the kitchen, deactivates the security system, unlocks the front door, and adjusts the thermostat.

All of these things are now possible thanks to a new wireless home control technology called Z-Wave. More than 125 independent manufacturers are developing Z-Wave-enabled products today. These manufacturers joined together in what is now known as the Z-Wave Alliance. The alliance, founded in January 2005, has the mission of promoting Z-Wave as the low-cost, open standard for wireless home control.

Industry giants such as Cooper, Intermatic®, Leviton, Monster® Cable, and Wayne-Dalton® understood that a standard was needed in order to make the long-promised "smart home" a reality. As Mark Walters from Leviton says, "Standards always win. Remember VHS versus Beta Max?" In order to create a standard in the home control space, it is

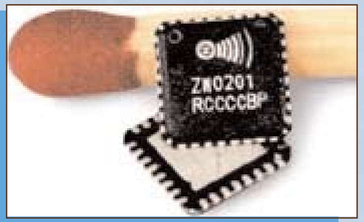
necessary to achieve three basic milestones. First, the technology must be reliable, i.e. easy to use and implement. Second, it must be affordable by the mainstream consumer market. Third, there must be a wide variety of products available using the technology. Given that Z-Wave is an affordable, wireless home control technology designed for easy installation and operation, and that a large number of manufacturers are developing products, we have a standard.

How It Works

Most of the companies in the alliance spend countless hours independently evaluating a multitude of technologies before selecting Z-Wave as the standard for their home control products. There is a lot of technical jargon explaining the technology that would overwhelm most consumers without an IT or engineering degree. In the end, the main thing consumers need to know about the technology is that it is "Wicked Good."

Z-Wave Introduction

Demian Martin



Z-Wave is one of several competing new technologies that offer to automate and control your home with no new wires. While not exactly new (X-10 has been promoting this for more than two decades), the challenge has always been to provide a combination of easy implementation, easy operation, and a clear value. X-10 was weak due to somewhat complicated implementation (especially going beyond the simplest of lighting control), reliability, and most of all, lack of compelling consumer value. Introduced when power was cheap and plentiful, remote control of lights was mostly a "geek" toy from before the term "geek" even meant something.

Things are much different today. It's possible to imbed enough power in a very inexpensive IC to do a lot of useful things. Wireless radio communications have moved way beyond crystal radios and can be very reliable. And now several standards have arisen to offer the value that X-10 didn't, plus with energy being expensive (and getting more so daily), security becoming more of a driving issue for many people, and convenience becoming a differentiator that can separate a home builder's product from another, opportunities abound for successful solutions.

Z-Wave is an early and well-developed contender for the home application. Controlled by a single entity, it has evolved fast and gained many products in its portfolio. It has two strong competitors: Insteon™ and ZigBee™. Insteon is a hybrid with both RF and Powerline communications giving it a potential edge in reliability, and ZigBee is aimed at commercial/industrial applications as well as home applications. However, Insteon has not gained as many industry partners, but has built many of the necessary devices themselves. And the developers of Insteon have a very deep experience in home control, having made and sold X-10 products for many years. ZigBee is an industry alliance focused on an IEEE standard with all of the challenges and pitfalls that come with such an effort. (The slowness of the release of 802.11N wireless networking is a very visible case in point.)

Yan gives a good introduction into Z-Wave in this short article. We intend to get similar introductions from key players in the other technologies.

> "More than 125 independent manufacturers are developing Z-Wave-enabled products today."

All Z-Wave-enabled products begin exactly the same way. A tiny chip containing everything related to the standard is embedded into the product. The chip turns any independent device into an intelligent networked product, which can be monitored and controlled from a remote location using radio waves as the means of communication. Rather than depending on a main control system located centrally in the home, Z-Wave products contain all of the network information within the chip. This "node" arrangement makes it extremely easy to expand the system as the needs for consumers change. Today these chips have been embedded into garage door openers, light switches, motorized window coverings, and thermostats, to name a few.

To control networked devices, a controller is needed in the network. Controllers use the same Z-Wave chip as the one found in a "slave" (i.e., a light switch) device. A controller may be a simple handheld device resembling a TV remote control. By pushing a button on the remote control, a relationship is formed between the slave and the controller. At that moment the network is born. Adding more devices to the network follows the same process as adding the first. More devices can be added to the network immediately, or five years later. As new devices are added to the network, the Z-Wave chips in the controllers and devices automatically update.

Once the network is created, the controller can be used to control the devices in the network in what is known as a "scene." Turning on your garage, kitchen, and living room lights as you enter your home is a scene. Dimming lights and closing window blinds in the family room to watch TV is also a scene. Scenes are created with the controller. The number of scenes in a network is only limited by the controller. Since multiple controllers can be added to the network, it is easy to dedicate controllers for specific functions. A controller in the kitchen may be assigned to trigger scenes such as "cooking," "entertaining," and "dining," while a controller in the bedroom may trigger "all lights off," "wake up kids," and "good morning."

Z-Wave communicates between devices and controllers using a two-way wireless signal. The devices, as they are added to the network, create a "mesh" between one another. The mesh allows a controller to communicate to any device in the house, regardless of the range between the two. For example, a controller in the bedroom sends a signal to the garage lights. The signal is not able to reach the garage directly so instead the controller talks to a kitchen appliance, which relays the signal to the garage light. Once the garage light turns off, the garage light switch sends a confirmation back to the bedroom controller acknowledging the command. Controllers in a Z-Wave network are smart in that they will automatically "mesh" between devices until they reach their intended target. If the path to a device changes over time, the network updates itself automatically. All of this activity is, of course, invisible to the user. There is nothing for the user to maintain or update. It just works! Given this "mesh" network configuration, the more devices installed in the home the better the network gets. Up to 232 devices can be added into a single Z-Wave network, which makes the technology suitable for any size home.

Home Control Solutions

Due to its wireless nature, Z-Wave is extremely friendly to the builder industry. Today, most home control solutions rely on structure wiring going from each device to a central controller located somewhere in the house. Structure wiring must be installed in the new home prior to the application of wallboard. Once the walls are up, it is extremely costly to make any changes. In contrast, adding Z-Wave devices during the construction phase, after the construction phase, and even after home delivery is a snap. There is no need to run new wires or change the existing electrical configuration. What makes Z-Wave even more attractive to builders and remodelers is an overall reduction in installation costs. Structure wiring runs can average more than $70 per drop plus the cost of the network device. With Z-Wave, the builder realizes an immediate reduction in infrastructure costs.

Rising energy costs are a major concern for consumers. Leaving lights on throughout the home can be extremely wasteful. Z-Wave-enabled home controls are ideally suited to provide energy-efficient solutions tailored to the needs of any consumer. Imagine leaving the house for a weekend trip. As you pull out of the driveway, kids play in the back seat, and a cup of fresh brew warms your hand. Immediately you begin to wonder: Did the kids turn off the lights in their rooms, bathroom, and closet? Is the coffeemaker off? Is the basement TV still on? With Z-Wave, a simple press of the garage door opener remote closes the garage door, which sends a "turn off" command to all the lights and appliances, and sets the thermostat to energy-save mode. What makes this example even more compelling is the fact that this scenario can be repeated every day, not just for special occasions. Rather than you adjusting your lifestyle to fit the schedule of a programmable thermostat, the Z-Wave-enabled thermostat follows your lifestyle all the time.

Z-Wave homes can easily be controlled remotely via cell phone control or Internet. Users simply log in to their homes from their cell phone or from any PC connected to the Internet. Once logged in, homeowners can easily turn lights on or off, unlock doors, activate security systems, etc. In short, anything that can be performed locally within the home can be performed from a remote location. For example, if a homeowner finds out a storm is going to hit his or her vacation home in Florida, he or she can simply connect to his or her vacation home and close all the motorized storm shutters without ever leaving the office.

Without a doubt, Z-Wave is the first technology to bring affordable wireless home control to the everyday consumer. From the momentum in the marketplace and the consumer adoption rates, it is likely Z-Wave will do the same thing to your home that the remote control did to the TV. UHD

The Author

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